REPAIR AND OVERHAUL

TURBOCHARGERS (GENERAL ELECTRIC) MODELS 7S1616A1, 7S1616B1, 7S1616B2, 7S1616B3, D1 AND D2

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CONTENTS

Page — Allied Pub.
SCOPE 1 GEK-61380
SPECIAL TOOLS AND EQUIPMENT . . . 1
TURBOCHARGER INSPECTION 2
DISASSEMBLY OF TURBOCHARGER . . 3
CLEANING 5
INSPECTION AND REWORK
  CRACK AND FLAW DETECTION 6
  TURBINE CASING ASSEMBLY 7
  BEARINGS 8
  SEALS 11
  BLOWER CASING 11
  BLOWER INLET 11
  DIFFUSER 11
  INLET FLANGE 12
  NOZZLE RING 12
  SHROUD 14
  NOSE PIECE. 14
  RETAINER 14
  ROTOR ASSEMBLY 15
REASSEMBLY OF TURBOCHARGER . . 16
DATA 22
TORQUE VALUES 22

SCOPE

This instruction covers "back-shop" operations required to repair and overhaul a turbocharger that is removed from a locomotive. For a description of the turbocharger and for instructions on removing and installing the turbocharger in a locomotive, refer to Publication GEK-61380.

SPECIAL TOOLS AND EQUIPMENT

The following items are required to repair and overhaul the turbocharger:

1. Hoist – capable of handling 1500-lb. load.

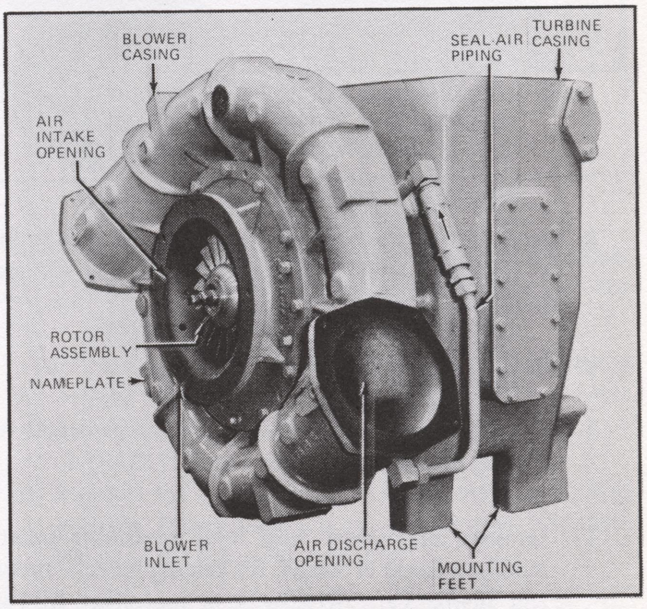

FIG. 1. MODEL 7S1616A1 TURBO, COMPRESSOR END.

FIG. 1, E-24450

2. Servicing fixture, Fig. 2 – details for making obtainable thru your GE Service Representative; request GE drawings 41E906813 and 41E906750.
3. Lifting fixture – Part 147X1916-1.
4. Eyebolts and slings.
5. Cleaning facilities.
6. Crack indicating equipment – Fluorescent Penetrant Method.
7. Blanking plates for hydrostatic and air testing turbine casing assembly – Fig. 11 gives details for making locally.

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*Revisions are indicated by marginal bars.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

Verify numbers for parts, tools, or material by using the Renewal Parts or Tool Catalogs, or contact your General Electric representative for assistance. Do not order from this publication.

GENERAL ELECTRIC

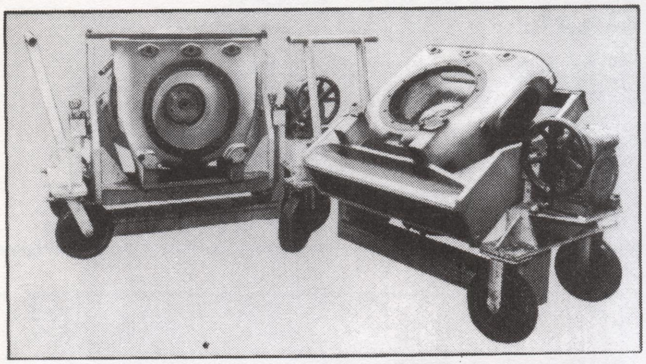

FIG. 2. SERVICING FIXTURE FOR INSPECTION, DISASSEMBLY AND REASSEMBLY OF TURBOCHARGER.

FIG. 2, E-23434

8. Water tank – minimum size is 36 in. x 36 in. x 36 in., or use same water tank used for testing cylinder assemblies.

9. Bearing puller – Part 147X2072.

10. Bearing installation tool – Fig. 21 gives details for making locally, or purchase Part 147X1197-1.

11. Internal micrometer with three measuring points, 2.000 to 2.400 in. range, for bearing bores – Brown and Sharpe, Part 599-281-24, or equivalent, GE Part 147X2139.

12. Internal micrometer with three measuring points, 2.800 to 3.200 in. range, for turbine-casing bearing bores (optional) – Brown and Sharpe Part 599-281-32, or equivalent, GE Part 147X2140.

13. Prybar – Snap-On No. 1250, or equivalent, Fig. 9, GE Part 147X2141.

14. Compressor-wheel puller – Part 147X2227.

15. Guide sleeve for installing rotor shaft – purchase Part 147X2078 or make locally, Fig. 33.

16. Protective cap for rotor stud – purchase Part 147X2077 or make locally, Fig. 8.

17. Guide pins for installing turbine inlet assembly – two required – purchase Part 147X2073 or make locally, Fig. 37.

18. Torque wrench, 10-150 lb.-ft. – Part 147X1649.

19. Torque wrench, 30-200 lb.-in., 3/8 in. drive – Part 147X2071.

20. Screwdriver, 3/8-in. drive, for diffuser screws – Snap-On No. F-31D, or equivalent, GE Part 147X2135.

21. Hex head driver, 3/16 in., 3/8-in. drive, for turbine-seal screws – Snap-On No. FA-6A, or equivalent, GE Part 147X2093.

22. Socket, 1/2 in., 12-point, 3/8 in. drive, for nozzle-ring hardware – Snap-On No. F-161, or equivalent, GE Part 147X2136.

23. Deep socket, 7/16 in., 12-point, 3/8-in. drive, for nozzle-ring hardware, blower seal bolts, etc. – Snap-On No. SF-141, or equivalent, GE Part 147X2137.

24. Combination wrench, 7/16 in., for nozzle-ring hardware – Snap-On No. OEX-140, GE Part 147X2087.

25. Combination wrench, 1/2 in., for nozzle-ring hardware – Snap-On No. OEX-160, GE Part 147X2088.

26. Open-end wrench adapter, 7/8 in., for rotor stud – Part 147X1594-1.

27. Box-wrench adapter, 9/16 in., for turbine casing cover bolts – Part 147X1772.

28. Box-wrench adapter, 3/4 in., for blower-inlet bolts and blower-casing nuts – Part 147X1775.

29. Box-wrench adapter, 15/16 in., for rotor nut, turbine inlet assembly bolts and turbine casing flange bolts – Part 147X1778.

30. Disk-holding fixture shown in Fig. 35 (optional) – details for making obtainable thru your GE Service Representative; request GE drawing 41E906726.

31. Micrometer depth gage, 0-6 in. range – for checking blower inlet clearance.

TURBOCHARGER INSPECTION

Prior to any disassembly, place the turbocharger assembly in a servicing fixture, Fig. 2, and make a preliminary inspection. Make a record of the conditions found, as they may affect the extent and nature of the rework required. A thorough inspection often will show conditions that existed on the engine from which the turbocharger was removed and which should be reported and corrected. This inspection should be continued thru the entire disassembly operation.

1. Record the serial number of the turbocharger assembly found on the nameplate attached to the lower half of the blower casing. See Fig. 1 for location.
2. Examine the turbocharger assembly for missing or broken components.
3. Examine the turbine inlet assembly for signs of overheating (excessively high pre-turbine temperature).
4. Examine the exterior, particularly at the mounting feet, for signs of damage due to improper tightness of mounting bolts.

DISASSEMBLY OF TURBOCHARGER

While not mandatory, the use of a servicing fixture, Fig. 2, is recommended since it allows more efficient disassembly and reassembly, reduces the possibility of accidents to maintenance personnel, and reduces the possibility of damage to the turbocharger components being worked on. With the turbocharger secured in a servicing fixture, refer to Fig. 40 and proceed with disassembly as follows:

1. Position the turbocharger with the compressor end up. Disconnect and remove the seal air piping.
2. Remove the bolts and lockwashers which secure the blower inlet to the blower casing. Install three 1/2 in.-13 bolts in holes provided in the blower inlet, and jack the blower inlet from its fit in the blower casing. Lift inlet clear, being careful not to bump and damage the compressor wheel.
3. Remove the bolts and lockwashers which secure the blower casing to the turbine casing. Install three 1/2 in.-13 bolts in holes provided in the turbine casing, and jack the blower casing from its fit on the turbine casing. Lift blower casing (and diffuser) clear of the turbocharger assembly.
4. Set the blower casing on the floor with the diffuser up, Fig. 3. Remove the six flat-head screws, then remove the diffuser. Handle the aluminum diffuser with care to avoid damage to the vanes and flat mounting surfaces.
5. Position the turbocharger with the turbine end up. Remove the lockwires, bolts and heat-treated washers which secure the turbine inlet assembly to the turbine casing. Install four 1/2 in.-13 bolts in holes provided in the inlet flange, and jack the inlet flange from its fit on the turbine casing. Lift the assembly, place it on a bench and disassemble as follows:

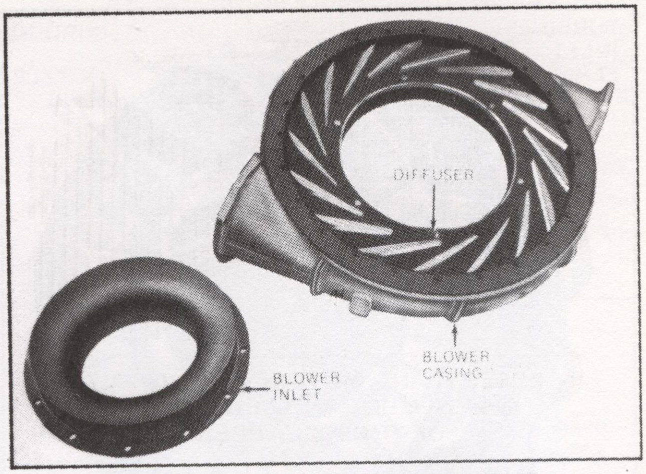

FIG. 3. BLOWER CASING ASSEMBLY.

FIG. 3, E-24455

   a. Remove and discard bolts and nuts which secure the retainer to the nose piece. Remove the retainer and nose piece.
   b. Remove and discard bolts and nuts which secure the shroud to the inlet flange. Remove the shroud and nozzle ring.

6. Position the turbocharger in its normal (feet-down) position. Disassemble and remove the rotor assembly, Fig. 6, in the following manner:
   a. Use one wrench applied on the flats near the end of the rotor stud to hold the stud stationary, and simultaneously use a second wrench to loosen and remove the rotor locknut.

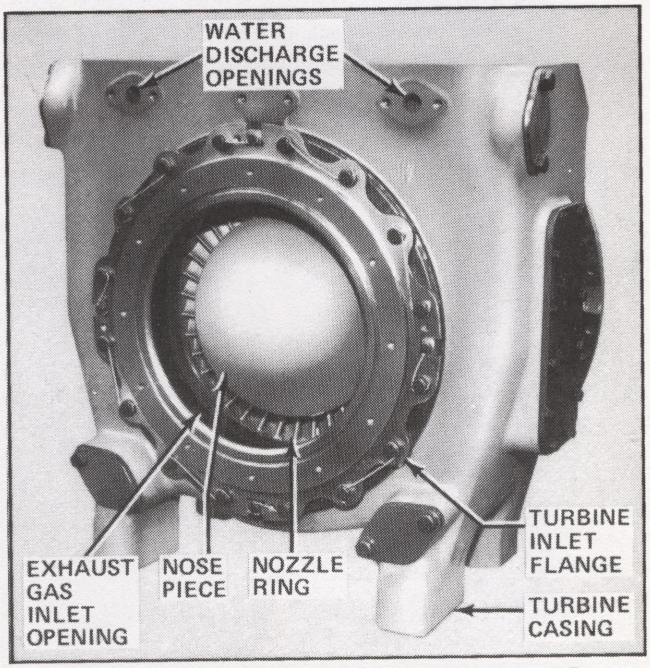

FIG. 4. MODEL 7S1616A1 TURBOCHARGER, TURBINE END.

FIG. 4, E-24451

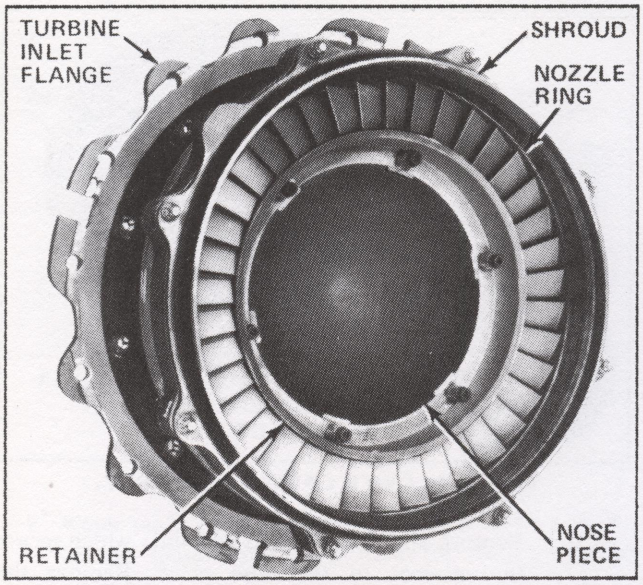
TURBINE INLET FLANGE
SHROUD
NOZZLE RING
RETAINER
NOSE PIECE

FIG. 5. TURBINE INLET ASSEMBLY.

FIG. 5, E-24454

b. Remove the turbine disk assembly together with the stud as a sub-assembly. First install a protective cap, Part 147X2077, Fig. 8, on the compressor end of the stud. Then lightly tap the end of the protective cap to force the disk from its doweled and rabbeted fit to the rotor shaft.

CAUTION: *Take precautions to prevent disk assembly from falling and becoming damaged as it is disengaged from the shaft.*

c. Install three 5/16 in.-18 screws in holes provided in the cap, and jack the cap from its fit between the shaft and compressor-wheel sleeve. Remove the cap from the rotor assembly.

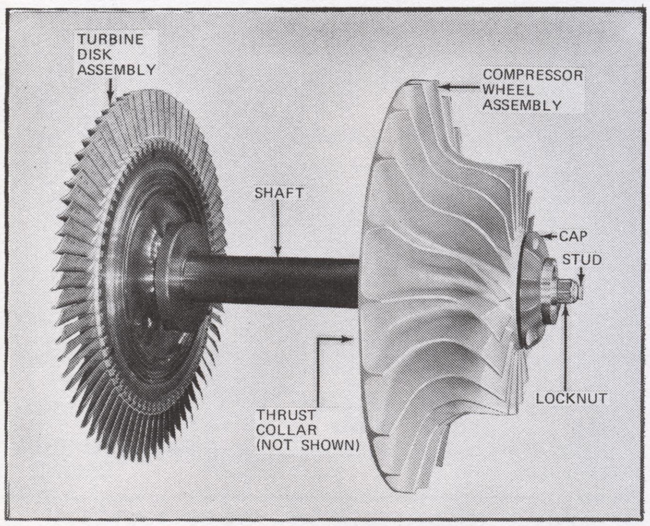
TURBINE DISK ASSEMBLY
COMPRESSOR WHEEL ASSEMBLY
SHAFT
CAP
STUD
THRUST COLLAR (NOT SHOWN)
LOCKNUT

FIG. 6. ROTOR ASSEMBLY.

FIG. 6, E-24453

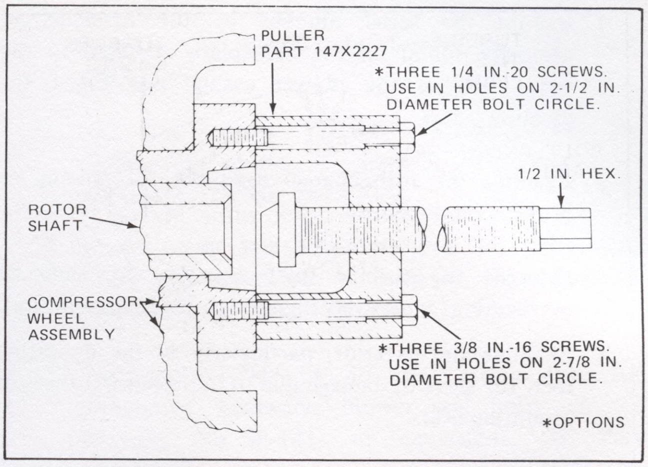
PULLER PART 147X2227
*THREE 1/4 IN.-20 SCREWS. USE IN HOLES ON 2-1/2 IN. DIAMETER BOLT CIRCLE.
1/2 IN. HEX.
ROTOR SHAFT
COMPRESSOR WHEEL ASSEMBLY
*THREE 3/8 IN.-16 SCREWS. USE IN HOLES ON 2-7/8 IN. DIAMETER BOLT CIRCLE.
*OPTIONS

FIG. 7. REMOVING COMPRESSOR-WHEEL ASSEMBLY WITH PULLER, PART 147X2227.

FIG. 7, E-26300

NOTE: *Some models require the use of three 1/4 in.-20 screws for jacking the cap loose. Use Class 8 screws having 1-1/2 in. length of threads.*

CAUTION: *Apply torque to all jack screws in small increments to prevent cocking the cap during its removal. Cocking the cap may deform the tapered segments of the cap.*

d. Apply puller, Part 147X2227, and pull the compressor-wheel assembly, together with the key, from its fit on the shaft, Fig. 7.

NOTE: *On early-production turbochargers, secure the puller to the compressor-wheel sleeve with the 3/8 in.-16 bolts; on current-production turbochargers use the 1/4 in.-20 bolts.*

e. Remove the lockwires and capscrews which secure the blower-end seal to the turbine casing. Install three 1/4 in.-20 screws in holes provided in the seal, and jack the seal from its fit in the turbine casing.

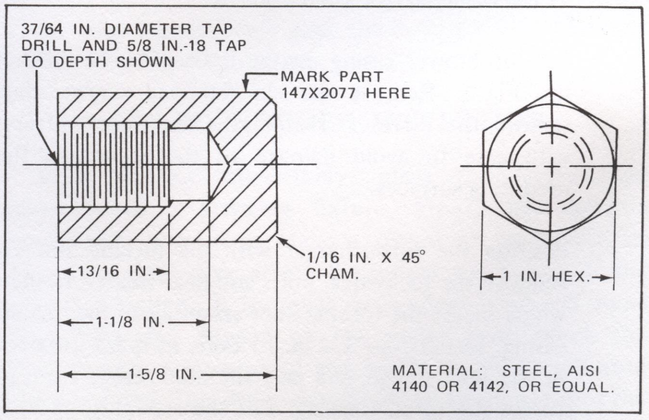
37/64 IN. DIAMETER TAP DRILL AND 5/8 IN.-18 TAP TO DEPTH SHOWN
MARK PART 147X2077 HERE
1/16 IN. X 45° CHAM.
13/16 IN.
1-1/8 IN.
1-5/8 IN.
1 IN. HEX.
MATERIAL: STEEL, AISI 4140 OR 4142, OR EQUAL.

FIG. 8. PROTECTIVE CAP FOR ROTOR STUD.

FIG. 8, E-23438

FIG. 9, E-23439

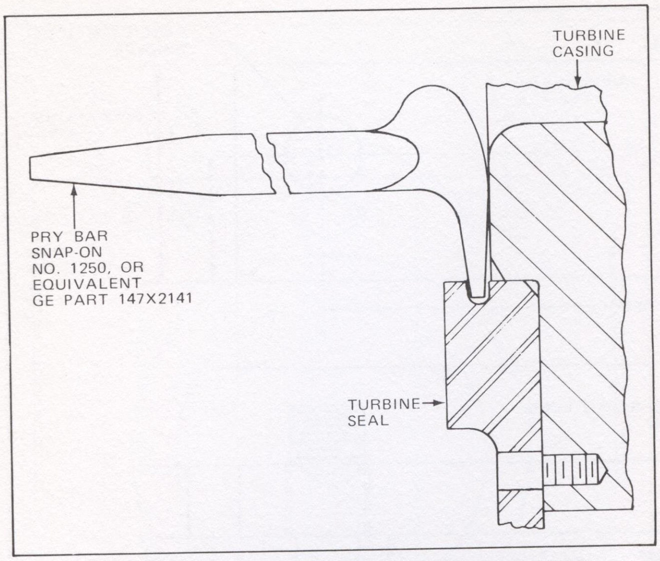
TURBINE CASING
PRY BAR SNAP-ON NO. 1250, OR EQUIVALENT GE PART 147X2141
TURBINE SEAL

FIG. 9. REMOVING TURBINE SEAL FROM TURBINE CASING.

f. Remove the thrust collar from the rotor shaft.

g. Remove the rotor shaft from the turbine casing.

h. Remove the lockwires and capscrews which secure the turbine-end seal to the turbine casing. Use a prybar, Fig. 9, and gently work around the seal circumference to pry the seal from its fit in the turbine casing.

i. Remove the rotor stud from the turbine disk. While holding the disk, apply a 7/8-in. open-end wrench to the flats on the stud to loosen and remove, Fig. 35.

CAUTION: *It is suggested that the rotor assembly be temporarily reassembled to keep these rotor components together. It is further suggested that the rotor assembly be stored in a felt-lined box to avoid accidental damage to this precision sub-assembly. Support rotor assembly on the shaft; not on the turbine disk or the compressor wheel.*

CLEANING

Thoroughly clean all component parts to facilitate inspection and repair, if required.

FIG. 10, E-23440

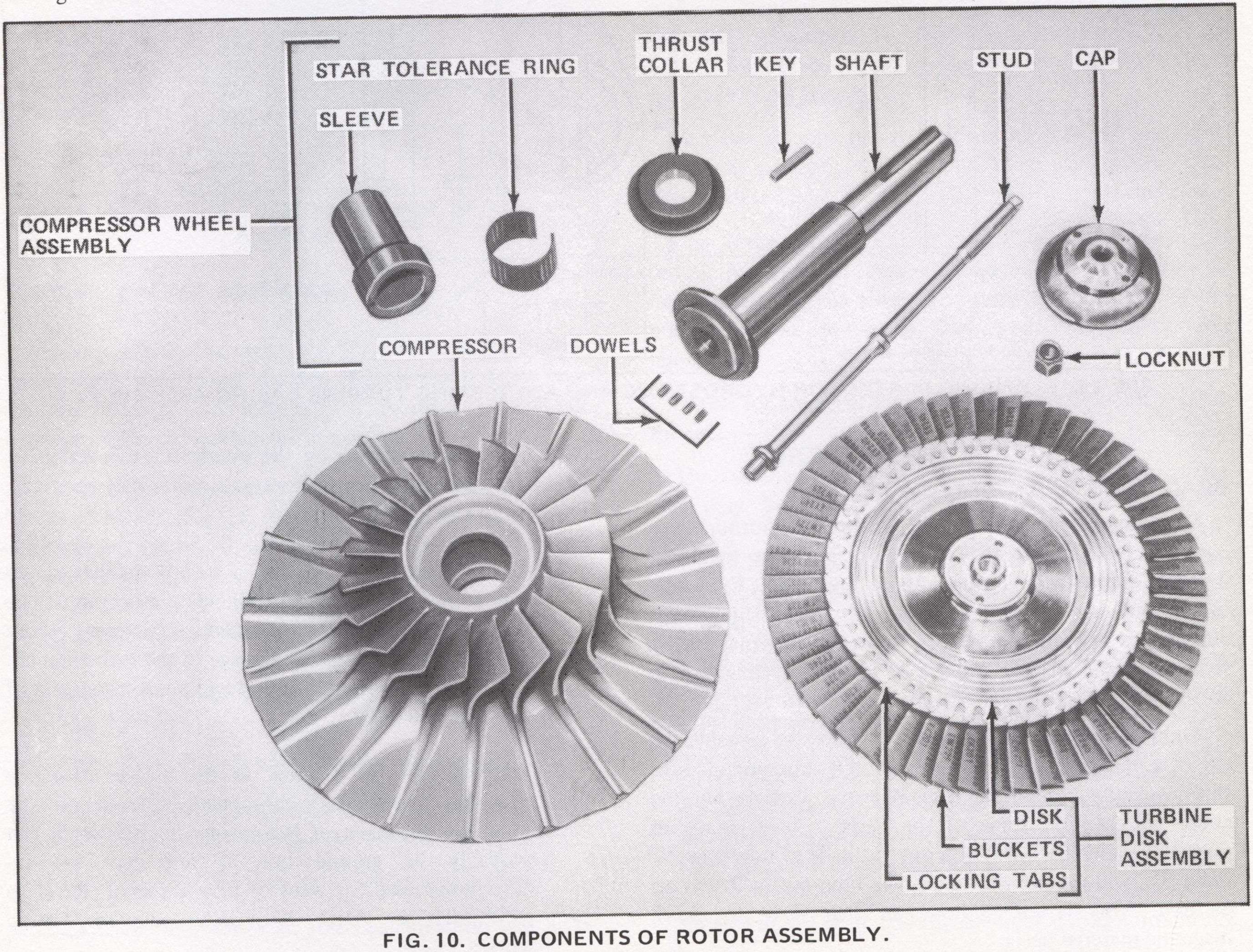
STAR TOLERANCE RING
SLEEVE
THRUST COLLAR
KEY
SHAFT
STUD
CAP
COMPRESSOR WHEEL ASSEMBLY
COMPRESSOR
DOWELS
LOCKNUT
DISK
BUCKETS
LOCKING TABS
TURBINE DISK ASSEMBLY

FIG. 10. COMPONENTS OF ROTOR ASSEMBLY.

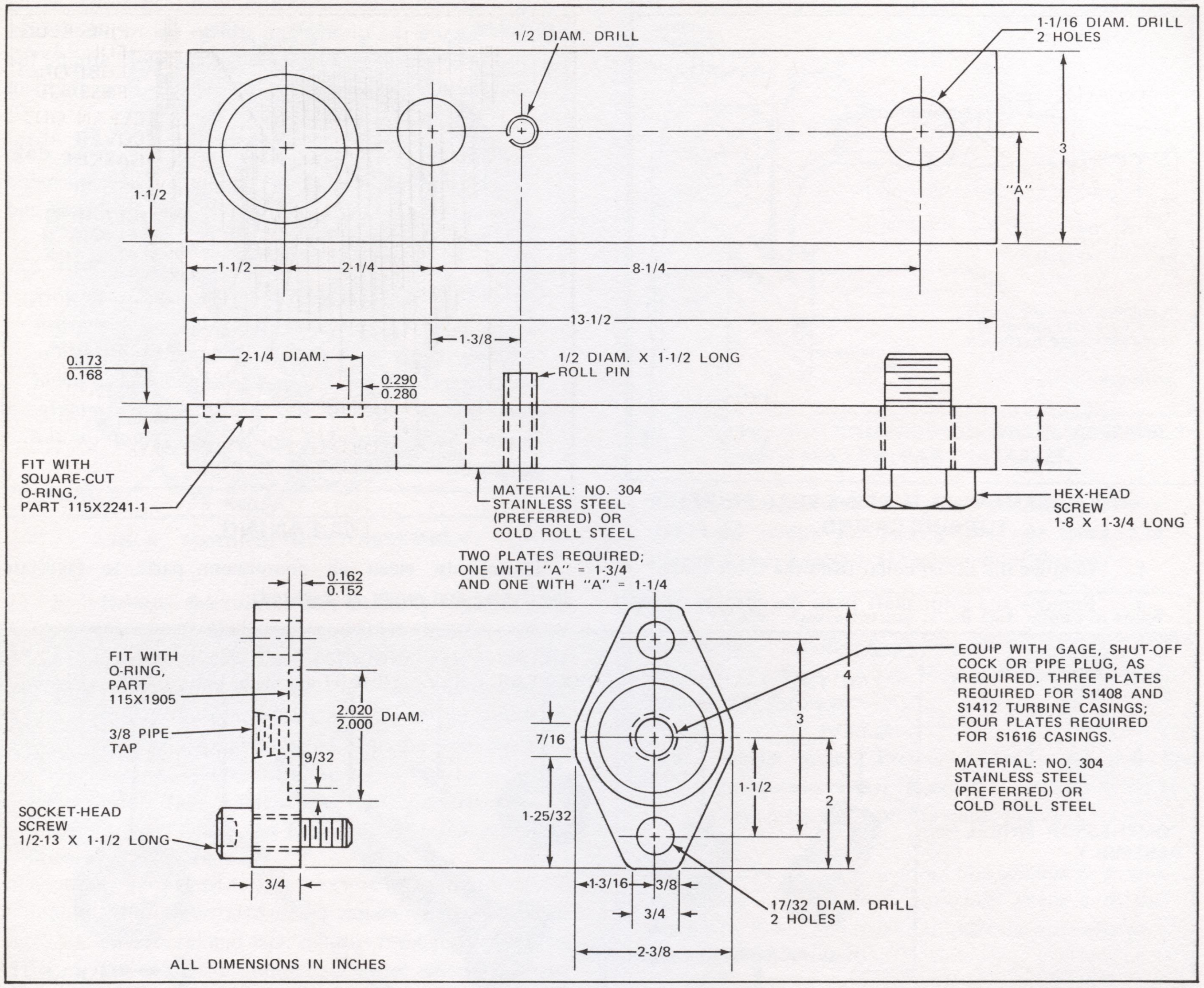
1/2 DIAM. DRILL
1-1/16 DIAM. DRILL
2 HOLES
3
"A"
1-1/2
1-1/2
2-1/4
8-1/4
13-1/2
1-3/8
0.173
0.168
2-1/4 DIAM.
0.290
0.280
1/2 DIAM. X 1-1/2 LONG
ROLL PIN
1
FIT WITH
SQUARE-CUT
O-RING,
PART 115X2241-1
MATERIAL: NO. 304
STAINLESS STEEL
(PREFERRED) OR
COLD ROLL STEEL
HEX-HEAD
SCREW
1-8 X 1-3/4 LONG
TWO PLATES REQUIRED;
ONE WITH "A" = 1-3/4
AND ONE WITH "A" = 1-1/4
0.162
0.152
FIT WITH
O-RING,
PART
115X1905
2.020
2.000
DIAM.
3/8 PIPE
TAP
9/32
SOCKET-HEAD
SCREW
1/2-13 X 1-1/2 LONG
3/4
7/16
1-25/32
1-3/16
3/8
3/4
2-3/8
1-1/2
3
2
4
EQUIP WITH GAGE, SHUT-OFF
COCK OR PIPE PLUG, AS
REQUIRED. THREE PLATES
REQUIRED FOR S1408 AND
S1412 TURBINE CASINGS;
FOUR PLATES REQUIRED
FOR S1616 CASINGS.
MATERIAL: NO. 304
STAINLESS STEEL
(PREFERRED) OR
COLD ROLL STEEL
17/32 DIAM. DRILL
2 HOLES
ALL DIMENSIONS IN INCHES

FIG. 11. BLANKING PLATES FOR HYDROSTATIC AND AIR TESTING TURBINE CASING ASSEMBLY.

FIG. 11, E-23441

INSPECTION AND REWORK

CRACK AND FLAW DETECTION

All turbocharger parts should be checked thoroughly at overhaul for the presence of cracks or flaws that may develop on surfaces during normal operation. Especially susceptible are the components in the turbine inlet assembly which are exposed to numerous thermal cycles. Rotor components are subject to thermal cycling and to stresses resulting from very high speeds.

While some cracks and flaws can be detected visually, the use of a nondestructive testing method is recommended for this inspection operation. The Magnetic Particle Method could be used on some of the parts – those made of magnetic materials – but other parts, made of nonmagnetic materials, will require the use of the Fluorescent Penetrant Method. This latter method can also serve to check magnetic-material parts.

The indications shown by the nondestructive test must be evaluated by the user before a decision can be made. Examples:

1. An indication of a crack in a turbine bucket would require rejection of the turbine-disk assembly, since this is a highly stressed part, and a subsequent failure would cause catastrophic damage to the turbocharger. This same logic is applicable to other components of the rotor assembly.

2. An indication of a crack in the blower casing, a relatively low-stressed component, should not be cause for rejection of the casing. Such a crack can probably be ground out, if not over 1/16 in. (1,59 mm) deep, or weld or plug repaired. Refer to INSPECTION AND REWORK, Blower Casing section.

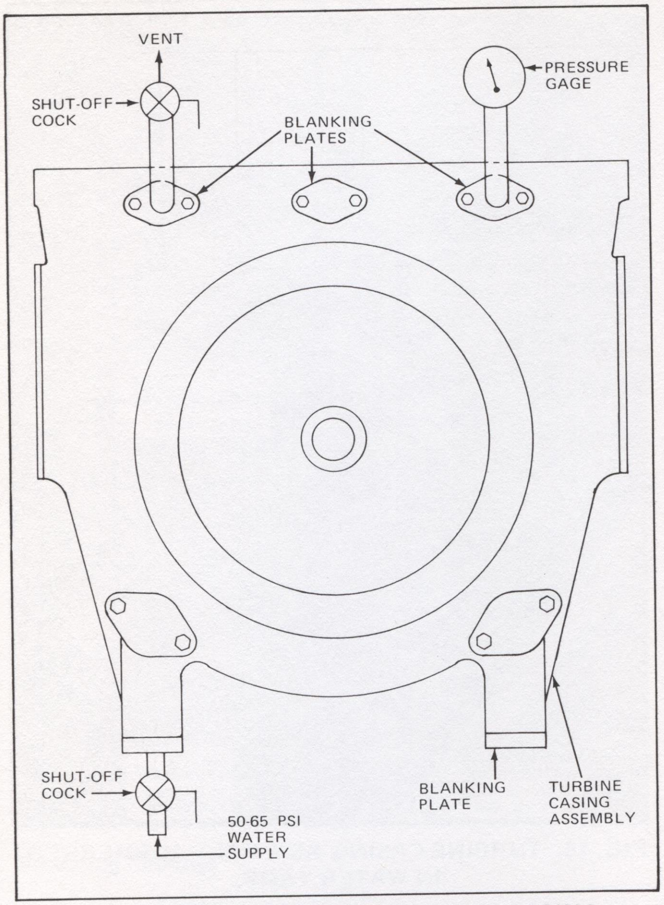
VENT
SHUT-OFF COCK
PRESSURE GAGE
BLANKING PLATES
SHUT-OFF COCK
50-65 PSI WATER SUPPLY
BLANKING PLATE
TURBINE CASING ASSEMBLY

FIG. 12. WATER TESTING TURBINE CASING ASSEMBLY.

FIG. 12, E-23442

FIG. 13, E-24452

TURBINE CASING ASSEMBLY

Visually check the assembly for indications of water leakage and mechanical damage. Check the bearing bore size and wear patterns and, only if excessive, remove the bearings. Refer to Bearings section.

To aid in finding cracks in the turbine casing, install blanking plates, Fig. 11, over all water inlet and outlet connections; apply 50 to 65 psi water pressure test and observe for leakage.

Apply test in the following manner:

1. Install blanking plates, gage and shut-off cocks, Fig. 12.
2. Open shut-off cock connected to water supply.
3. Partially open upper shut-off cock to vent all air from inside the turbine casing, then close this cock.
4. Close the shut-off cock in the water supply line.
5. Test for 30 minutes at 50-65 psi pressure, and note any drop in pressure and evidence of leakage.

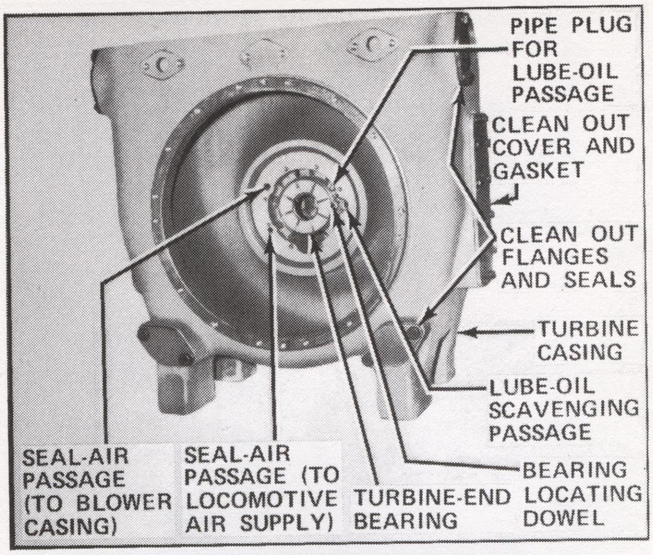
PIPE PLUG FOR LUBE-OIL PASSAGE
CLEAN OUT COVER AND GASKET
CLEAN OUT FLANGES AND SEALS
TURBINE CASING
LUBE-OIL SCAVENGING PASSAGE
BEARING LOCATING DOWEL
SEAL-AIR PASSAGE (TO BLOWER CASING)
SEAL-AIR PASSAGE (TO LOCOMOTIVE AIR SUPPLY)
TURBINE-END BEARING

FIG. 13. TURBINE CASING ASSEMBLY, TURBINE END.

Remove the two side clean-out covers and the four clean-out flanges. If found, clean all corroded or eroded surfaces. Replace all covers and flanges using new gaskets, seals and lockwashers. Tighten cover bolts with 20-25 lb.-ft. (27-34 N·m) torque; tighten flange bolts to 105-115 lb.-ft. (142-156 N·m) torque.

Remove all pipe plugs. Rod out all lube-oil, sealing-air and water passages. Replace pipe plugs using sealing tape, Part 147X1638.

Check the four mounting feet surfaces for fretting. If found, machine or dress all four mounting surfaces in one plane to a 125 micro-inch finish. Remove minimum material from mounting feet while performing this operation.

Check for cracks around the four mounting-bolt holes in the feet.

The turbine casing is a special-quality grey-iron casting and may be repair-welded using the "cold-technique" method. Use 1/8-in. diameter filler metal per AWS A5.15-69, Class ENi-C1 or Class ENi-Fe. After welding, check machined surfaces for freedom from distortion.

Small defects may also be corrected by plugging; that is, by tap-drilling the area containing the defect, pipe-tapping and installing an appropriate sized pipe plug.

> **CAUTION:** *Welding and plugging to correct defects are applicable only to outside surfaces; they are not successfully used on inner surfaces (surfaces directly exposed to hot exhaust gases).*

Retap exhaust stack and turbine-inlet assembly mounting hole.

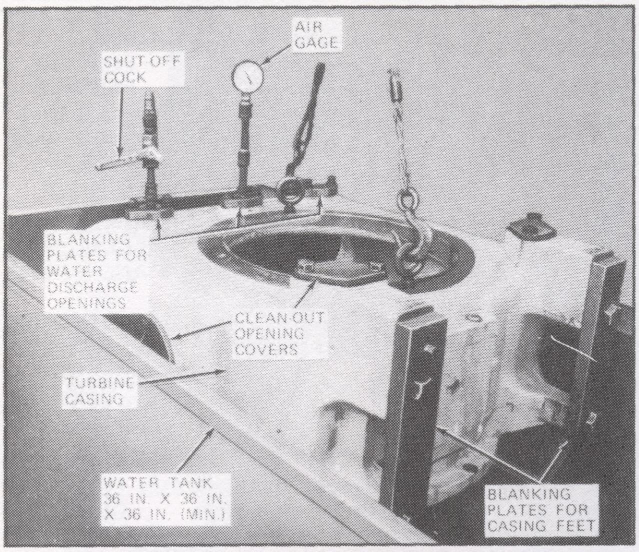
AIR GAGE
SHUT-OFF COCK
BLANKING PLATES FOR WATER DISCHARGE OPENINGS
CLEAN-OUT OPENING COVERS
TURBINE CASING
WATER TANK 36 IN. X 36 IN. X 36 IN. (MIN.)
BLANKING PLATES FOR CASING FEET

FIG. 14. LOWERING TURBINE CASING ASSEMBLY INTO WATER TANK.

FIG. 14, E-23443

As a final test of the turbine casing assembly, apply air pressure to the water passages to check the integrity of the casting, gaskets, seals and pipe plugs. Perform this test in the following manner:

1. Provide a tank having minimum dimensions 36 in. x 36 in. x 36 in.

NOTE: *The same tank used for air-testing cylinders may be used for this operation.*

2. Fill the tank with treated water – one part Vantrol 915 grinding fluid* (or an equivalent synthetic, water-soluble rust inhibitor) to fifty parts of water.
3. Apply blanking plates to all water inlet and outlet openings, Fig. 14.
4. Connect an air supply to one of the blanking plates, and apply 20-25 psi air pressure to the casing assembly.

WARNING: *Personal injury could result from the explosion of parts if the specified pressures are exceeded.*

5. Lower the turbine casing assembly into the water until it is completely submerged, Fig. 15.
6. Allow the air test to proceed for 20 minutes. If no bubbles appear, the assembly is satisfactory. If any bubbles appear, correct the cause of the leak and retest.

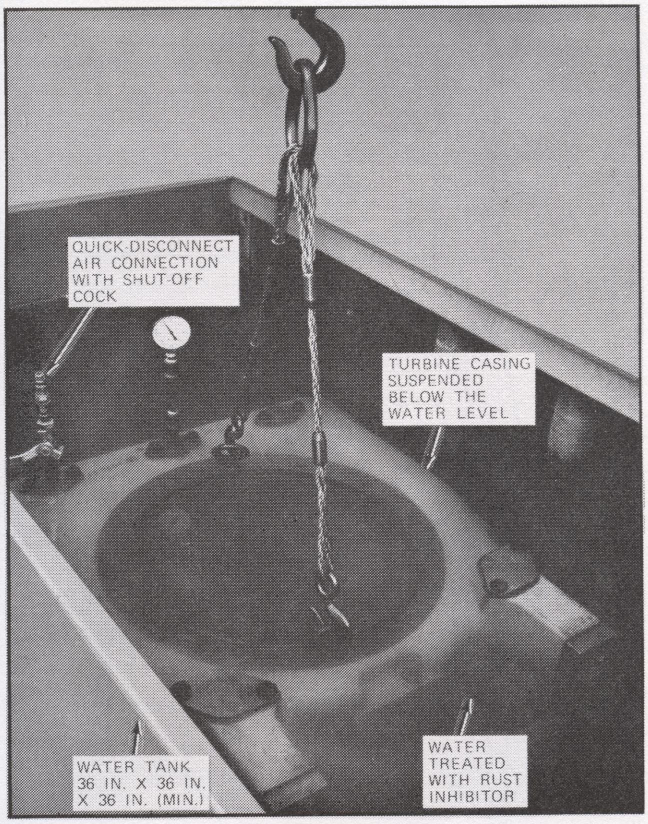
QUICK-DISCONNECT AIR CONNECTION WITH SHUT-OFF COCK
TURBINE CASING SUSPENDED BELOW THE WATER LEVEL
WATER TANK 36 IN. X 36 IN. X 36 IN. (MIN.)
WATER TREATED WITH RUST INHIBITOR

FIG. 15. TURBINE CASING ASSEMBLY SUBMERGED IN WATER TANK.

FIG. 15, E-23444

BEARINGS

General

All turbocharger bearings are precision-type sleeve bearings and are replaceable without machining or scraping. Each bearing is constructed of a steel shell which supports several layers of specially formulated bearing material in both the bore and on the thrust face.

Each turbocharger has two bearings which are an interference fit in the turbine-casing bore. Bearings are correctly oriented in the casing by a dowel and groove to produce positive lubrication (and bearing support) for the rotating rotor assembly.

Each bearing has a running surface (the bore) and a thrust surface. The running surface may be in the form of a cylinder, or it may be formed by three axial lands with relief between adjacent lands. The latter are sometimes referred to as "three-lobe bearings." The thrust surface may be a solid surface, or it may be formed by eight, radial groove-land relief configurations. Different combinations of bearings are used, depending on the particular turbocharger model and its application; consult the Renewal Parts Catalog for proper bearings used with each model of turbocharger.

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*Can be purchased from Van Straaten Chemical Company, 630 West Washington Blvd., Chicago, Illinois 60606.

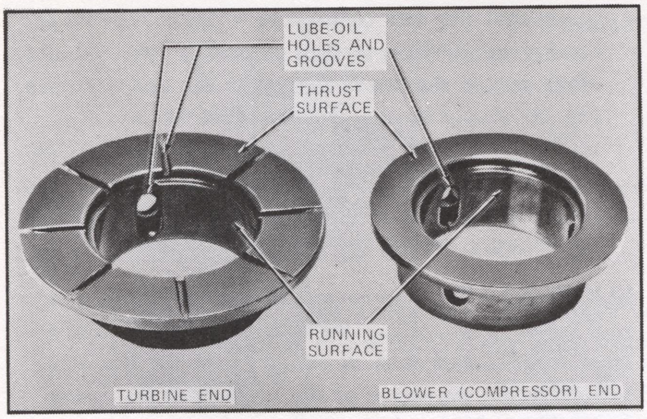

LUBE-OIL HOLES AND GROOVES
THRUST SURFACE
RUNNING SURFACE
TURBINE END
BLOWER (COMPRESSOR) END

FIG. 16. TYPICAL TURBOCHARGER BEARINGS.

> **CAUTION:** *Never remove bearings from the turbine casing unless they are to be renewed.*

Inspection — Used Bearings

With the bearings assembled in the turbine casing, visually check the bearing surfaces and measure the bearing bores. Renew or reuse the bearings, as determined by the bearing inspection criteria outlined in Table I.

Renewing Bearings

1. Disassemble the turbocharger so the bearings, in the turbine-casing assembly, are accessible. For each bearing, install puller, Part 147X2072, arranged as shown in Fig. 19. Then rotate the puller nut until the bearing is completely pulled from its fit in the turbine casing.

TABLE I, BEARINGS

Condition	Action
Pieces of bearing material broken off	Renew bearing
Cracks in bearing material	Renew bearing
Pitted bearing surface	Renew bearing
Light scratches in bearing surface	Reuse bearing — do not attempt to remove scratches
Deep scratches in bearing surface	Renew bearing
Worn bearing surface, finish good, radial clearance with shaft within limits (see DATA section)	Reuse bearing
Worn bearing surface, finish good, radial clearance with shaft excessive (see DATA section)	Renew bearing
Excessively worn thrust surface, turbine end, Fig. 17	Renew bearing

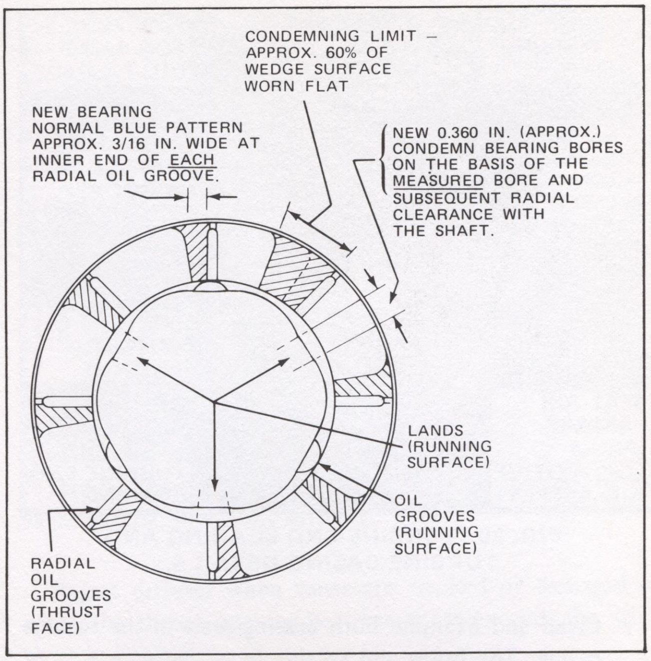

CONDEMNING LIMIT – APPROX. 60% OF WEDGE SURFACE WORN FLAT
NEW BEARING NORMAL BLUE PATTERN APPROX. 3/16 IN. WIDE AT INNER END OF EACH RADIAL OIL GROOVE.
NEW 0.360 IN. (APPROX.) CONDEMN BEARING BORES ON THE BASIS OF THE MEASURED BORE AND SUBSEQUENT RADIAL CLEARANCE WITH THE SHAFT.
LANDS (RUNNING SURFACE)
OIL GROOVES (RUNNING SURFACE)
RADIAL OIL GROOVES (THRUST FACE)

FIG. 17. TURBOCHARGER-BEARING WEAR PATTERNS.

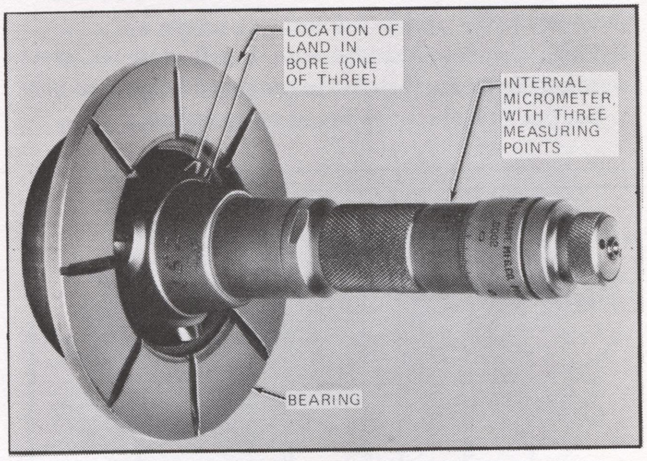

LOCATION OF LAND IN BORE (ONE OF THREE)
INTERNAL MICROMETER, WITH THREE MEASURING POINTS
BEARING

FIG. 18. MEASURING BEARING BORE.

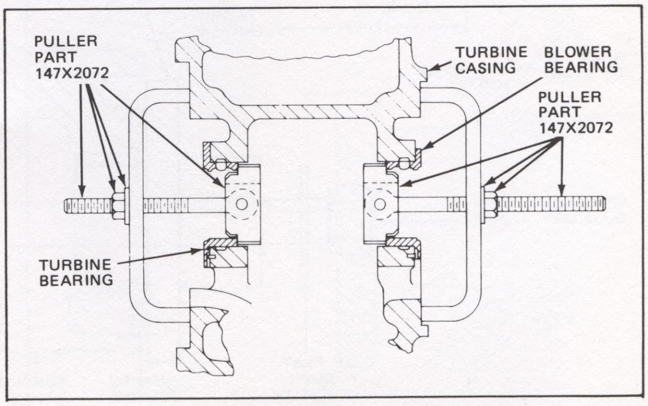

PULLER PART 147X2072
TURBINE CASING
BLOWER BEARING
PULLER PART 147X2072
TURBINE BEARING

FIG. 19. REMOVING BEARINGS FROM TURBINE CASING.

FIG. 16, E-23445
FIG. 17, E-26203
FIG. 18, E-23501
FIG. 19, E-26204

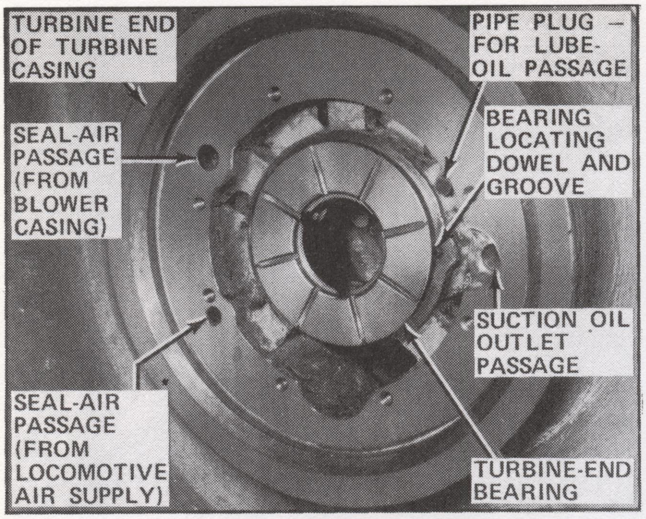

TURBINE END OF TURBINE CASING
PIPE PLUG – FOR LUBE-OIL PASSAGE
SEAL-AIR PASSAGE (FROM BLOWER CASING)
BEARING LOCATING DOWEL AND GROOVE
SUCTION OIL OUTLET PASSAGE
SEAL-AIR PASSAGE (FROM LOCOMOTIVE AIR SUPPLY)
TURBINE-END BEARING

FIG. 20. TURBINE-END BEARING AND TURBINE-CASING DETAILS.

FIG. 20, E-26205

2. Clean and examine both bearing seats in the turbine casing. The bores and seating faces must be free of dirt, burrs, nicks and picked-up metal. Bores must be 2.9382/2.9375 in. (74,630/74,613 mm).

3. Clean the new bearings with a soft cloth or paper towel. Examine the new bearings and be assured they are free of nicks, scratches or other defects.

4. Super-cool the new bearings to –120 F (–84 C) and quickly install them in their respective bearing bores. Make certain the dowel engages in the dowel groove, Fig. 20. Apply bearing installer, Part 147X1197-1, to retain bearings in position, since they tend to creep out of position as they warm up to turbine-casing temperature. After bearings reach turbine-casing temperature, remove the bearing installer tool.

SUGGESTION: *Super-cool the bearing installation tool when super-cooling the bearings. This relatively large super-cooled mass in contact with the bearings will delay the expansion of the bearings in the casing bore. This additional time allows the assembler to install the bearings without interference. Should the bearings expand during assembly before they are in the correct final position, use the bearing installation tool to force them into contact with the two faces of the turbine casing.*

WARNING: *To prevent personal injury, wear protective gloves when handling the super-cooled bearings and bearing installation tool.*

5. After bearings reach turbine-casing temperature, check to assure the back faces of the bearings are in complete contact with the faces of the turbine casing;

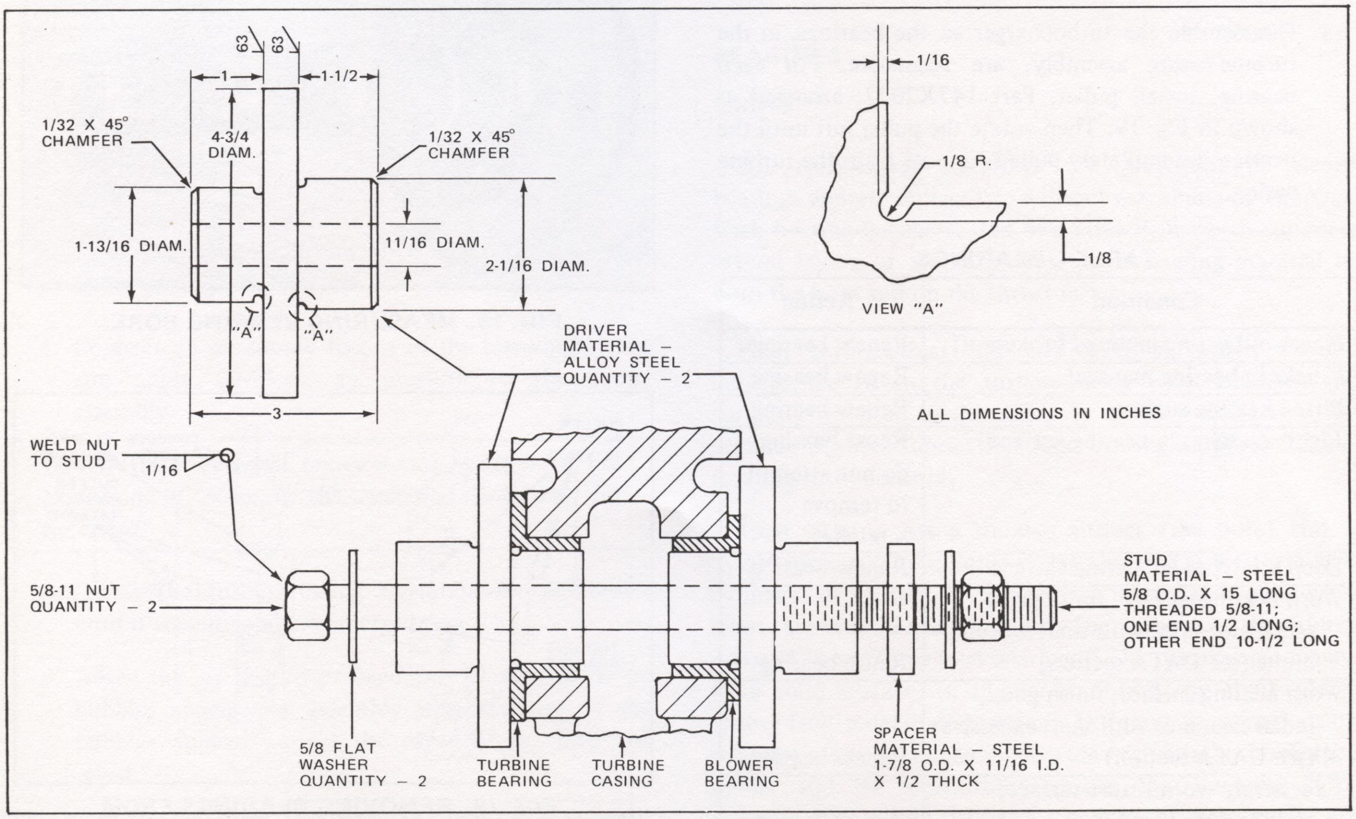

63
63
1
1-1/2
1/32 X 45° CHAMFER
4-3/4 DIAM.
1/32 X 45° CHAMFER
1-13/16 DIAM.
11/16 DIAM.
2-1/16 DIAM.
"A"
"A"
3
DRIVER MATERIAL – ALLOY STEEL QUANTITY – 2
1/16
1/8 R.
1/8
VIEW "A"
ALL DIMENSIONS IN INCHES
WELD NUT TO STUD
1/16
5/8-11 NUT QUANTITY – 2
STUD MATERIAL – STEEL 5/8 O.D. X 15 LONG THREADED 5/8-11; ONE END 1/2 LONG; OTHER END 10-1/2 LONG
5/8 FLAT WASHER QUANTITY – 2
TURBINE BEARING
TURBINE CASING
BLOWER BEARING
SPACER MATERIAL – STEEL 1-7/8 O.D. X 11/16 I.D. X 1/2 THICK

FIG. 21. BEARING INSTALLATION TOOL.

FIG. 21, E-23449A

TABLE II, DIFFUSERS

Application Turbo Model	Diffuser Drawing No.	No. Vanes	Vane Height (in.)	Throat Opening New (in.)	Average Throat Opening Condemning (in.)
7S1616A1	41E902751P1	17	0.723-0.719	1.233-1.213	1.233
7S1616B1, B2	41E902751P2	17	0.692-0.687	1.233-1.213	1.233

a 0.0015-in. (0,038-mm) thickness gage should not enter between these two surfaces at any point around the circumference.

6. Check the alignment of the bearings. Apply a light film of Prussian blue to the thrust surface of the rotor shaft, assemble the shaft in its normal location in its bearings and, with a light pressure on the end of the shaft, rotate the shaft. Remove the shaft and check the pattern left on the thrust face of the turbine bearing. Assemble the shaft thru the blower-end bearing, and repeat the procedure to check the pattern left on the thrust face of the blower bearing.

   On newly installed bearings, an uneven contact pattern indicates the bearing is not properly seated and must be removed. Before installing a new bearing, check for dirt, burrs or improper alignment between the bearing groove and the locating dowel.

SEALS

Clean seals and remove all nicks, burrs and accumulations of carbon (especially in the turbine-seal labyrinth). Check for warpage by laying them on a flat plate; reject if warped over 0.002 in. (0,051 mm). Check the bore of each seal and the matching shaft or thrust collar diameter; reject if bore or running clearance exceeds the values given in the DATA section.

BLOWER CASING

Clean and remove all old sealant from mounting faces. Casing must be free of nicks and cracks.

This grey iron casting may be repaired, if required, by plugging (small defects) or by welding, using the "cold-technique" method. Use 1/8-in. diameter filler metal per AWS 5.15-69, Class ENi-C1 or Class ENi-Fe. After welding, check machined surfaces for freedom from distortion.

BLOWER INLET

Clean and remove all old sealant from the mounting face. Inlet must be free of nicks and cracks.

If weld repairing is required, follow the same procedure outlined under Blower Casing section.

DIFFUSER

Handle the diffuser with care, to avoid damage to the vanes and flat mounting surfaces.

Reject diffuser when vanes are cracked or damaged or when the throat opening between vanes exceeds the value given in Table II.

NOTE: *Enlarged throat openings result from a defective engine air filtration system, which should be reported and the condition on the locomotive corrected to avoid repeated damage to turbocharger and other engine components.*

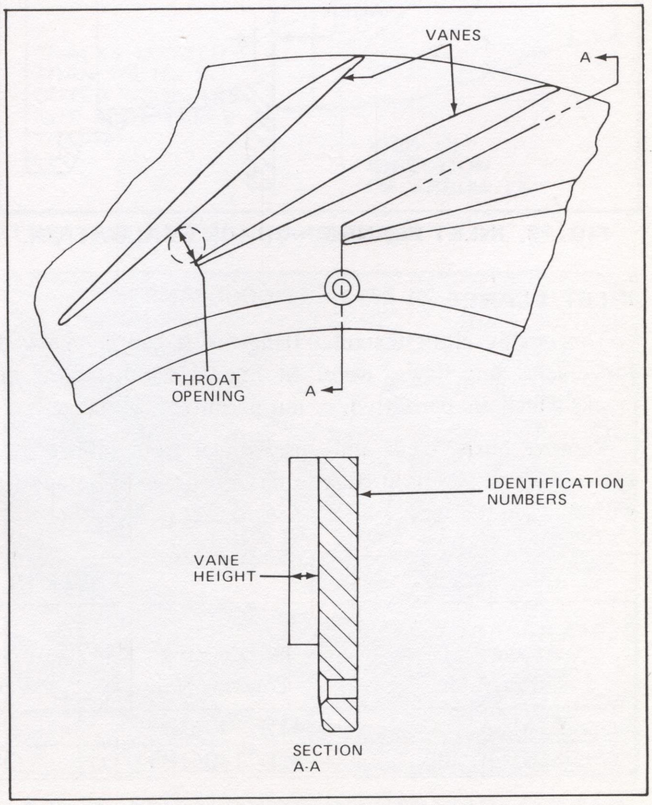


FIG. 22. DIFFUSER.

FIG. 22, E-23450

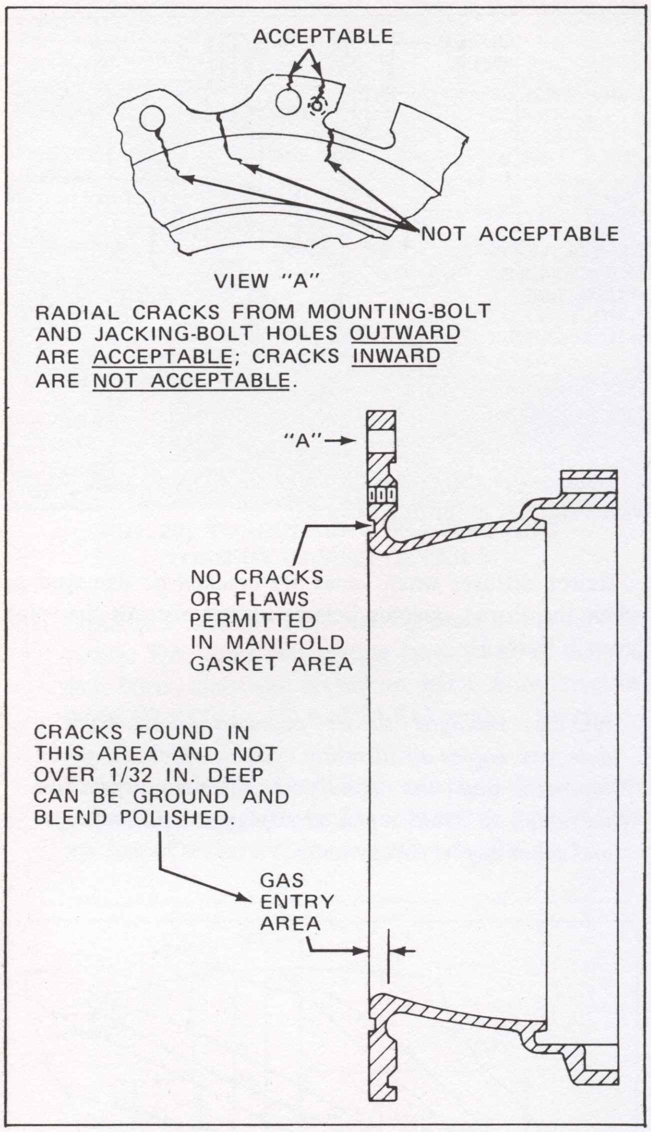

ACCEPTABLE
NOT ACCEPTABLE
VIEW "A"
RADIAL CRACKS FROM MOUNTING-BOLT AND JACKING-BOLT HOLES OUTWARD ARE ACCEPTABLE; CRACKS INWARD ARE NOT ACCEPTABLE.
"A"
NO CRACKS OR FLAWS PERMITTED IN MANIFOLD GASKET AREA
CRACKS FOUND IN THIS AREA AND NOT OVER 1/32 IN. DEEP CAN BE GROUND AND BLEND POLISHED.
GAS ENTRY AREA

FIG. 23. INLET FLANGE — CRACK EVALUATION.

FIG. 23, E-26209

INLET FLANGE

Thoroughly clean the inlet flange so it can be checked for cracks and flaws. Refer to Fig. 23 for locations of cracks which are permitted, or not permitted, in flanges.

Remove burrs, nicks and upset metal from rabbet fits. Clean exhaust-manifold clamp-ring bolt holes by retapping with a 1/2 in.-13 tap.

NOZZLE RING

Thoroughly clean the nozzle ring so it can be checked for cracks and flaws. Refer to Fig. 24 for locations of cracks which are, or are not, permitted in nozzle rings. Refer to Fig. 25 for treatment of torn metal in vanes.

While all nozzle rings look alike, it is mandatory that the total flow area (determined by measuring the vane gaps) be within the limits given in Table III. Failure to provide the correct flow area will produce an incorrect rotor speed and subsequently incorrect turbocharger air output. Reject nozzle ring if total flow area is outside the limits given in Table III; bending of all vane airfoil sections to correct flow area is not permitted; bending of a few damaged vanes to restore correct vane gap is permissible, but vanes must be rechecked for cracks after this repair operation.

To determine the nozzle-ring flow area:

1. Establish the 14.255-in. gage diameter by one of the following methods:
   a. Apply layout fluid to the nozzle-ring vanes. Use a hermaphrodite caliper and scribe lines on all vanes at a 14.255-in. diameter. Register the caliper on the machined 11.755/11.750 inside diameter when performing this operation, Figs. 24 and 26.
   b. Apply layout fluid to the nozzle-ring vanes. Set up a geometric center in the bore of the nozzle ring and, with a divider, scribe lines on all vanes at a 14.255-in. diameter.
   c. Establish a suitable length for a spacer pin to locate a taper gage on the 14.255-in. gage diameter, Fig. 26.
2. Use a taper gage, or other suitable measuring device, and measure a minimum of nine equally spaced vane gaps. Measurements must agree with the values given in Table III. A maximum of three gaps may measure ±0.010 in. of the value given in the table if the average measurement of all vane gaps is ±0.003 in. of the value given in the table. Calculate the average vane gap.

TABLE III, NOZZLE RINGS

Application Turbo Model	Nozzle Ring Drawing No.	No. Vanes	Vane Gap* at 14.255-in. Gage Diameter (in.)	Total Flow Area (Nominal) (sq. in.)
7S1616A1	41D714061P3	39	0.370	28.2
7S1616B1, B2	41D714061P2	39	0.341	26.0

*Tolerance on individual vane gaps is ±0.006 in.; tolerance on the average vane gap is ±0.003 in.

FIG. 24, E-26210

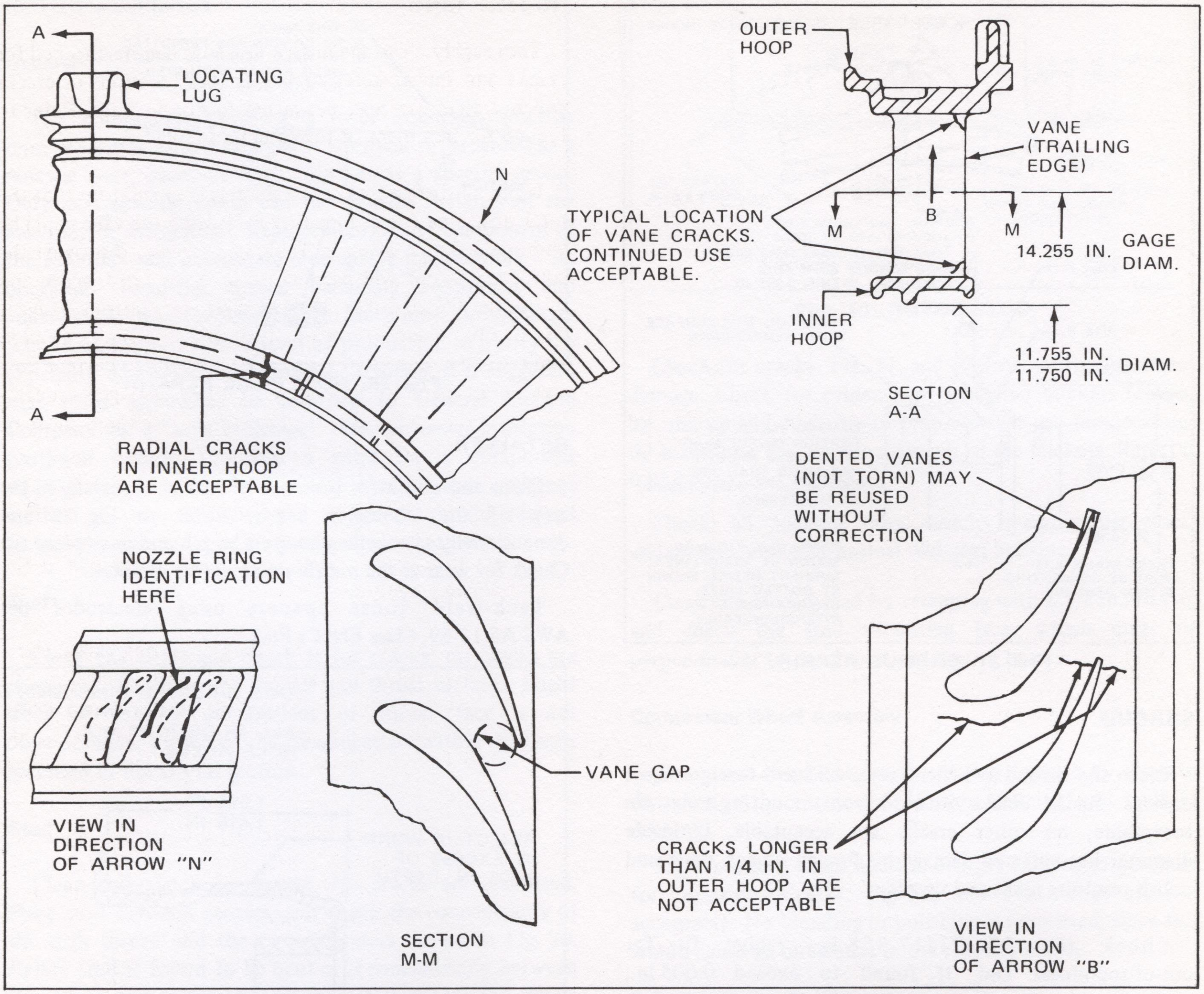

A
LOCATING LUG
N
A
RADIAL CRACKS IN INNER HOOP ARE ACCEPTABLE
NOZZLE RING IDENTIFICATION HERE
VIEW IN DIRECTION OF ARROW "N"
OUTER HOOP
VANE (TRAILING EDGE)
TYPICAL LOCATION OF VANE CRACKS. CONTINUED USE ACCEPTABLE.
B
M
M
14.255 IN.
GAGE DIAM.
INNER HOOP
11.755 IN. / 11.750 IN.
DIAM.
SECTION A-A
DENTED VANES (NOT TORN) MAY BE REUSED WITHOUT CORRECTION
VANE GAP
SECTION M-M
CRACKS LONGER THAN 1/4 IN. IN OUTER HOOP ARE NOT ACCEPTABLE
VIEW IN DIRECTION OF ARROW "B"

FIG. 24. NOZZLE RING — CRACK EVALUATION AND SIZE DETERMINATION.

FIG. 25, E-23503

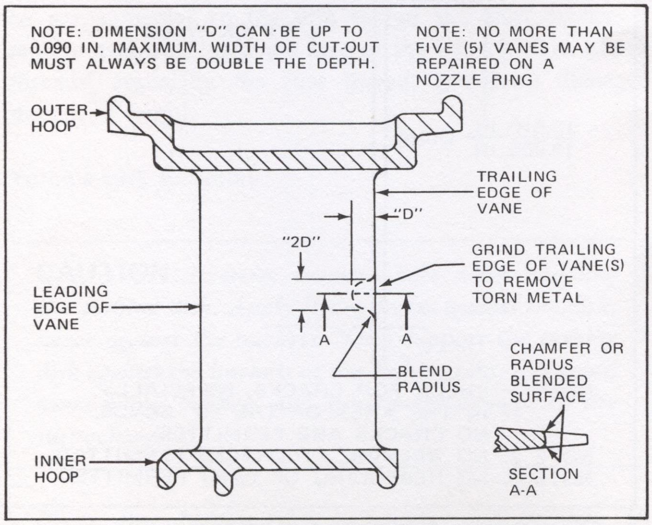

NOTE: DIMENSION "D" CAN BE UP TO 0.090 IN. MAXIMUM. WIDTH OF CUT-OUT MUST ALWAYS BE DOUBLE THE DEPTH.
NOTE: NO MORE THAN FIVE (5) VANES MAY BE REPAIRED ON A NOZZLE RING
OUTER HOOP
TRAILING EDGE OF VANE
"D"
"2D"
GRIND TRAILING EDGE OF VANE(S) TO REMOVE TORN METAL
LEADING EDGE OF VANE
A
A
BLEND RADIUS
CHAMFER OR RADIUS BLENDED SURFACE
INNER HOOP
SECTION A-A

FIG. 25. TREATMENT OF TORN METAL IN NOZZLE-RING VANES.

FIG. 26, E-26211

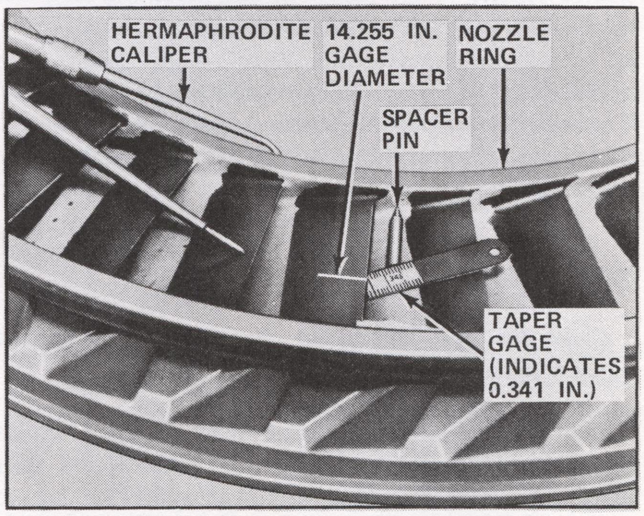
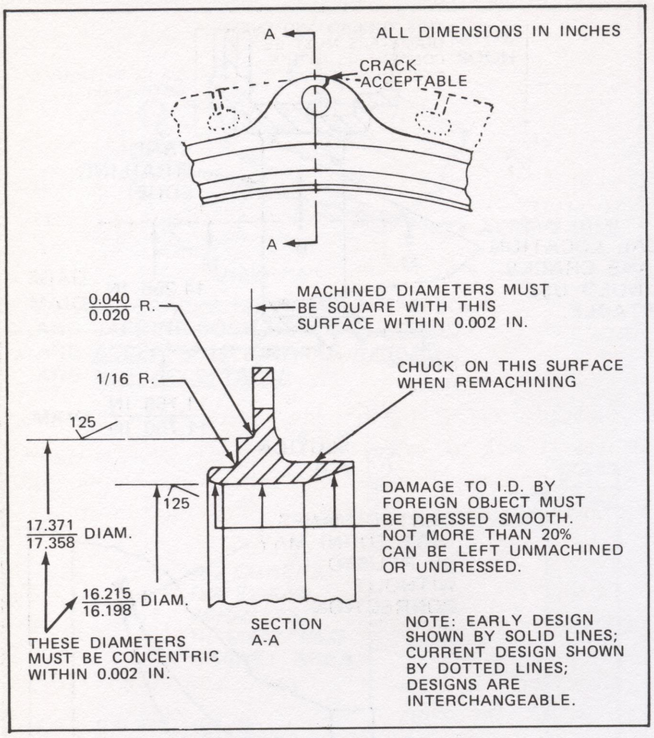

HERMAPHRODITE CALIPER
14.255 IN. GAGE DIAMETER
NOZZLE RING
SPACER PIN
TAPER GAGE (INDICATES 0.341 IN.)

FIG. 26. ESTABLISHING THE GAP DIAMETER AND MEASURING VANE GAP.


A
ALL DIMENSIONS IN INCHES
CRACK ACCEPTABLE
A
0.040/0.020 R.
MACHINED DIAMETERS MUST BE SQUARE WITH THIS SURFACE WITHIN 0.002 IN.
1/16 R.
CHUCK ON THIS SURFACE WHEN REMACHINING
125
125
17.371/17.358 DIAM.
16.215/16.198 DIAM.
THESE DIAMETERS MUST BE CONCENTRIC WITHIN 0.002 IN.
SECTION A-A

DAMAGE TO I.D. BY FOREIGN OBJECT MUST BE DRESSED SMOOTH. NOT MORE THAN 20% CAN BE LEFT UNMACHINED OR UNDRESSED.

NOTE: EARLY DESIGN SHOWN BY SOLID LINES; CURRENT DESIGN SHOWN BY DOTTED LINES; DESIGNS ARE INTERCHANGEABLE.

FIG. 27. SHROUD REPAIR.

FIG. 27, E-26221

SHROUD

Clean the shroud and check for cracks and foreign object damage. Radial cracks outward from mounting holes are acceptable; no other cracks are acceptable. If inside diameter has suffered damage by foreign object, dress and polish resulting nicks and upsets.

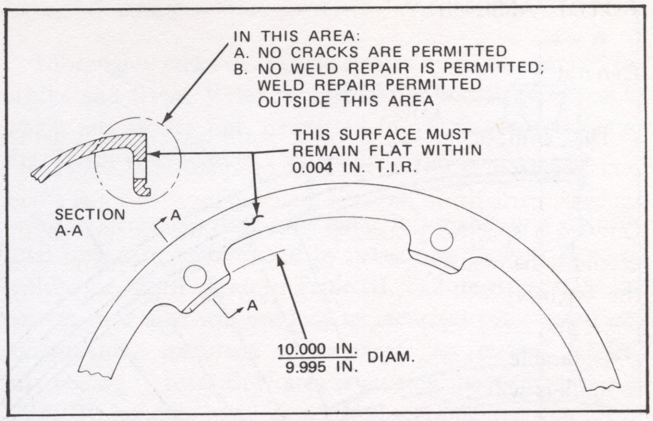
Check the 17.371/17.358 in. rabbet fit for out-of-roundness and, if found to exceed 0.005 in., remachine the fits shown in Fig. 27. Chuck the shroud, true-up relative to the rabbet fit and mounting face, and machine the two diameters to the dimensions given.

NOTE: *The surfaces will probably not be machined completely around the periphery; partially-machined surfaces will probably result diametrically opposite one another.*

NOSE PIECE

Clean the nose piece and check it for cracks and dimensional distortion per Fig. 28.

Cracks, as specified in Fig. 28, may be repair welded using the TIG welding process and AWS-ER-308 filler metal. Fixturing may be required while welding to minimize distortion and thereby keep the nose piece within the dimensional limits specified in Fig. 28.


SECTION A-A
A
A
10.000 IN./9.995 IN. DIAM.

IN THIS AREA:
A. NO CRACKS ARE PERMITTED
B. NO WELD REPAIR IS PERMITTED; WELD REPAIR PERMITTED OUTSIDE THIS AREA

THIS SURFACE MUST REMAIN FLAT WITHIN 0.004 IN. T.I.R.

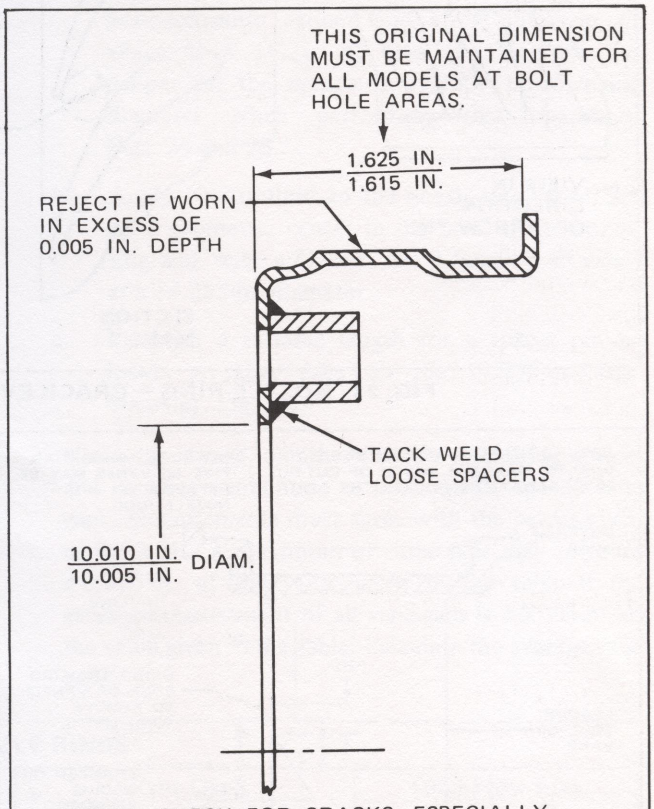
FIG. 28. NOSE PIECE REPAIR.

FIG. 28, E-26222

RETAINER

Clean and check for presence of cracks, especially in the area of the 90-degree bends. Refer to Fig. 29 and dimensionally check the clamping length and nose-piece fit. Check for wear at the nozzle-ring locating dimples.

Tack-weld loose spacers using electrodes per AWS A5.11-69, Class ENi Cr Fe-2.


THIS ORIGINAL DIMENSION MUST BE MAINTAINED FOR ALL MODELS AT BOLT HOLE AREAS.
1.625 IN./1.615 IN.
REJECT IF WORN IN EXCESS OF 0.005 IN. DEPTH
TACK WELD LOOSE SPACERS
10.010 IN./10.005 IN. DIAM.

NOTE 1: CHECK FOR CRACKS, ESPECIALLY IN THE AREA OF THE 90° BENDS; NO CRACKS ARE PERMITTED.
NOTE 2: NO WELDING OF CRACKS PERMITTED.
NOTE 3: NO REBENDING OF PART PERMITTED.

FIG. 29. RETAINER INSPECTION AND REPAIR CRITERIA.

FIG. 29, E-26223

ROTOR ASSEMBLY

General

The component parts of a rotor assembly, whether removed from a turbocharger at overhaul or provided as a renewal part, must be kept together as a specific group. Only as a specific group can the dynamic balance of the assembly be maintained. Replacement of any component of the assembly will necessitate rebalancing the assembly – an operation requiring special balancing equipment and considerable operator competence. Since most turbocharger rebuilders will not have a level of production to justify the expensive equipment and operator training, it is suggested that rotor assemblies be returned to General Electric Company on a "unit exchange" basis whenever inspection (outlined below) indicates a need for a component replacement. If conditions are such that the unit exchange method is not feasible, the customer should request technical assistance thru his Service Representative.

Shaft

Clean the shaft and check it for cracks; no cracks are permitted. Examine the journal and thrust surfaces. Slight wear or scoring of journals or thrust face is not objectionable, providing the clearances are within the limits specified in the DATA section.

Stud

Clean and check for cracks. No cracks are permitted. Place stud between centers, and check the concentricity of the disk thread and the two diameters shown in Fig. 30. Reject stud if found to be bent or if concentricity between the thread and two diameters exceeds 0.002 in. TIR. While between centers, check the disk mounting face; this must be perpendicular to the disk thread and flat; deburr, if required, especially in the area of the wrench flats. Check threads, especially the first thread, and dress damaged threads, if found.

Turbine Disk Assembly

> **CAUTION:** *Exercise extreme care when handling the turbine disk. Apply lifting forces against the disk; never against the buckets. Never support the turbine disk against the buckets or the locking tabs; this could cause loose buckets and subsequent damage to the turbocharger.*

Clean the turbine disk assembly and remove all accumulations of carbon.

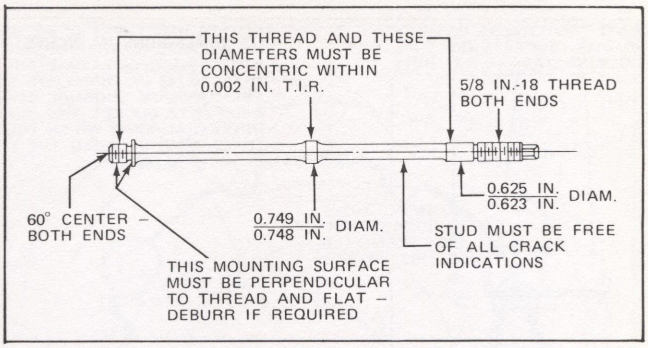

THIS THREAD AND THESE DIAMETERS MUST BE CONCENTRIC WITHIN 0.002 IN. T.I.R.
5/8 IN.-18 THREAD BOTH ENDS
0.625 IN. / 0.623 IN. DIAM.
60° CENTER – BOTH ENDS
0.749 IN. / 0.748 IN. DIAM.
STUD MUST BE FREE OF ALL CRACK INDICATIONS
THIS MOUNTING SURFACE MUST BE PERPENDICULAR TO THREAD AND FLAT – DEBURR IF REQUIRED

FIG. 30. ROTOR STUD.

FIG. 30, E-23457

Check for cracks, Fig. 31, and evidence of foreign object damage. Check for evidence of stretched buckets (caused by abnormally high pre-turbine exhaust gas temperature) by measuring the outside diameter of the buckets. Reject if found to exceed 16.148 in.

Check all locking tabs, which must be in place, undamaged, and snug against disk and buckets.

Clean the stud thread by retapping with a 5/8 in.-18 tap, and check the stud mounting face, which must be perpendicular to the thread and free of burrs.

Compressor Wheel Assembly

Clean and check for cracks, erosion (caused by abrasive dirt passing the engine-air filtration system), and signs of rubbing.

Light erosion, small nicks and slight rubbing is no cause for rejection. Cracks, Fig. 32, and bent vanes are not acceptable. No blending or polishing is permitted, since this would cause an imbalance in the rotor assembly.

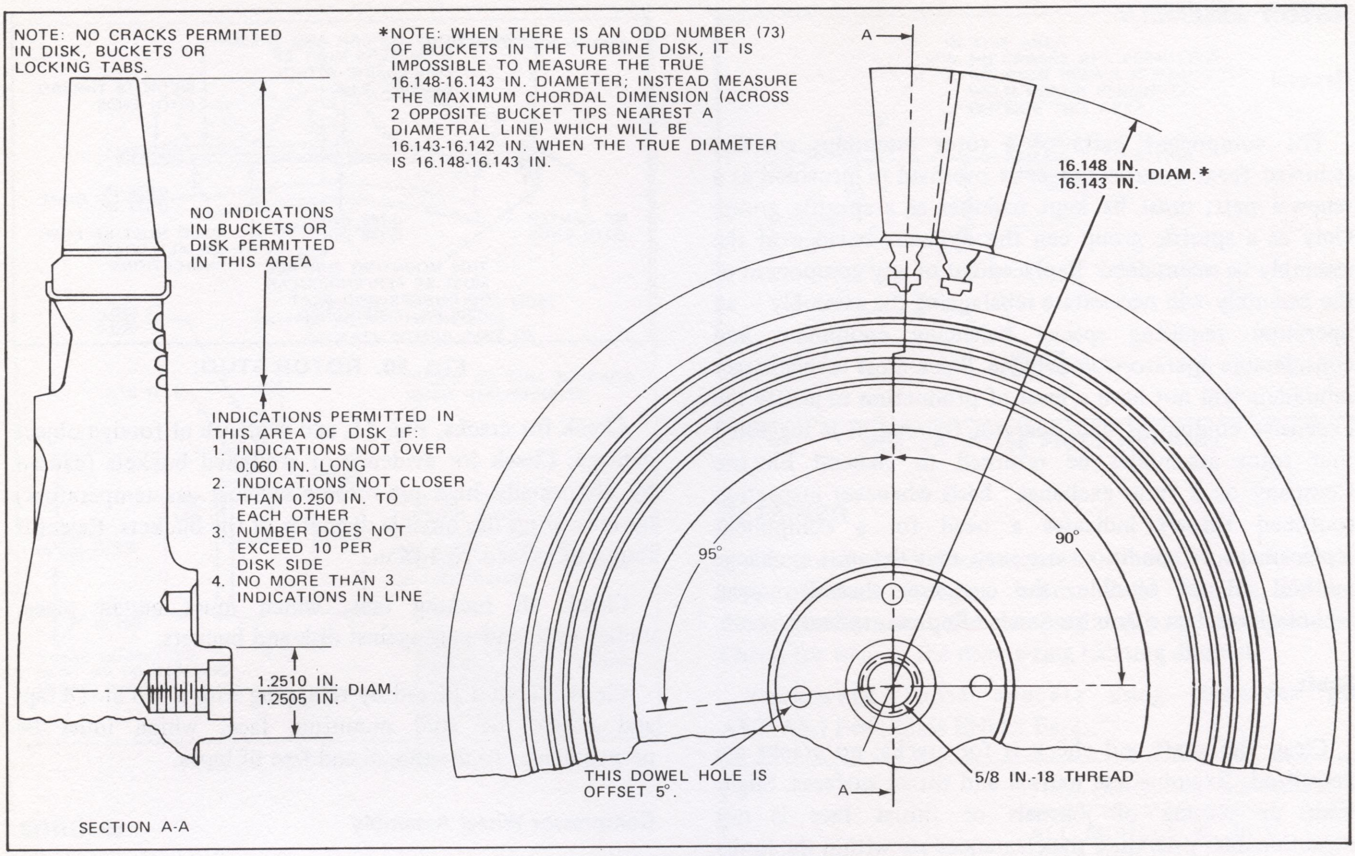
Thrust Collar

Clean and examine for cracks; reject if part is found to be cracked. Up to three circumferential grooves in the thrust surface, not over 0.060 in. wide and not over 0.010 in. deep, are permitted, but these must be polished to remove sharp outer edges. Check for high spots on the thrust surface by using Prussian blue and a surface plate; remove high spots if found.

Cap

Clean and examine for cracks; reject if part is found to be cracked. If the nut contacting surface is galled, redress this surface smooth and square with the cap bore within 0.001 in. TIR.

If equipped with permanent magnets (for CHEC excitation speed probe), make certain magnets are in place, secure and like poles are in the same direction.



NOTE: NO CRACKS PERMITTED IN DISK, BUCKETS OR LOCKING TABS.

*NOTE: WHEN THERE IS AN ODD NUMBER (73) OF BUCKETS IN THE TURBINE DISK, IT IS IMPOSSIBLE TO MEASURE THE TRUE 16.148-16.143 IN. DIAMETER; INSTEAD MEASURE THE MAXIMUM CHORDAL DIMENSION (ACROSS 2 OPPOSITE BUCKET TIPS NEAREST A DIAMETRAL LINE) WHICH WILL BE 16.143-16.142 IN. WHEN THE TRUE DIAMETER IS 16.148-16.143 IN.

NO INDICATIONS IN BUCKETS OR DISK PERMITTED IN THIS AREA

INDICATIONS PERMITTED IN THIS AREA OF DISK IF:
1. INDICATIONS NOT OVER 0.060 IN. LONG
2. INDICATIONS NOT CLOSER THAN 0.250 IN. TO EACH OTHER
3. NUMBER DOES NOT EXCEED 10 PER DISK SIDE
4. NO MORE THAN 3 INDICATIONS IN LINE

FIG. 31. TURBINE DISK ASSEMBLY.

FIG. 31, E-26206

Check the taper for effective fitting. Apply a light film of Prussian blue to the female taper in the compressor wheel sleeve. Assemble the cap in the sleeve, rotate it slightly, then remove the cap. All four tapered segments should show a blue pattern; reject the cap if it does not show such a pattern.

REASSEMBLY OF TURBOCHARGER

After all components have been cleaned, inspected and processed per preceding instructions, refer to Fig. 40 and reassemble in the following manner:

1. Position the turbine casing in a servicing fixture, Fig. 2.

2. If bearings were removed from the turbine casing, install new bearings. Refer to Bearings section for installation instructions.

3. Before assembling the rotor shaft, flush the oil passages in the turbine casing assembly. Plug five of the six radial oil holes in the two bearings with corks or rubber stoppers. Pour clean solvent into the oil inlet hole until it runs clean out of the unplugged bearing hole. Move a plug and repeat the flushing process until all six holes show clean solvent flow. Remove all plugs from bearing holes.

4. To avoid damaging the bearings with the step on the rotor shaft, provide a guide sleeve, Fig. 33. This can be made locally or purchased as Part 147X2078. Clean the shaft and the guide sleeve, assemble the two parts together, apply a light coating of clean engine lube-oil to the shaft journals and thrust surface and carefully install the shaft in the turbine casing assembly. Remove the guide sleeve from the shaft.

5. Apply a bead of RTV-106 sealant to the seal mounting face in the turbine casing, Fig. 34. Assemble the turbine seal and secure with capscrews coated with anti-seize compound, Fel-Pro C-100*. Tighten capscrews with 5-8 lb.-ft. (6,8-10,8 N·m) of torque, and lockwire pairs of screw heads in a tightening direction. See Fig. 40. Make certain lockwire does not cover seal air passages. RTV-106 sealant can be ordered from General Electric as Part 41B562849P156.

NOTE: *If any RTV-106 enters the seal air passages, allow it to set and then cut it out of the passages.*

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*Product of Felt Products Mfg. Co.

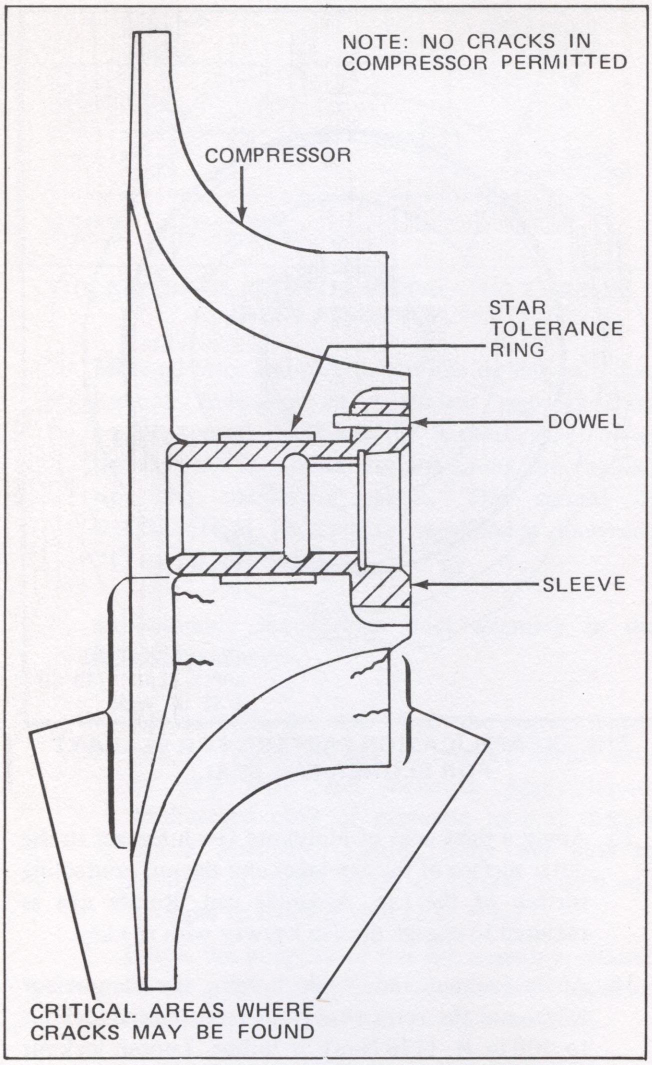

NOTE: NO CRACKS IN COMPRESSOR PERMITTED
COMPRESSOR
STAR TOLERANCE RING
DOWEL
SLEEVE
CRITICAL AREAS WHERE CRACKS MAY BE FOUND

FIG. 32. COMPRESSOR WHEEL ASSEMBLY.

6. Check the radial clearance between the turbine-seal bore and the rotor shaft, which should be 0.0035-0.006 in. (0,089-0,152 mm). This is dimension "F" on Fig. 40.

7. Apply anti-seize compound, Fel-Pro C-100, to the disk thread of the rotor stud. Assemble the rotor stud to the turbine disk assembly, and secure with 60 lb.-ft. (81 N·m) of torque. Apply torque at the 7/8-in. flats on the rotor stud (Fig. 35).

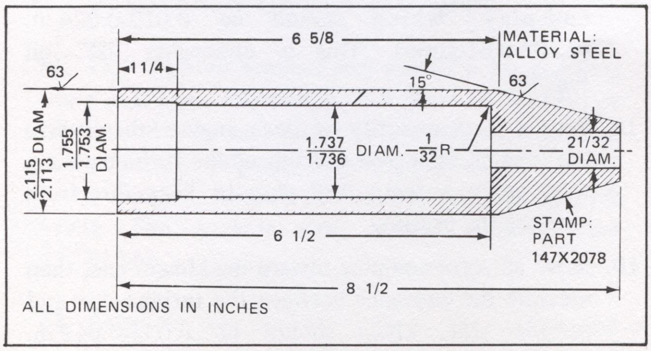

6 5/8
MATERIAL: ALLOY STEEL
1 1/4
63
15°
63
2.115
2.113 DIAM.
1.755
1.753 DIAM.
1.737
1.736 DIAM.
1/32 R
21/32 DIAM.
6 1/2
STAMP: PART 147X2078
8 1/2
ALL DIMENSIONS IN INCHES

FIG. 33. GUIDE SLEEVE.

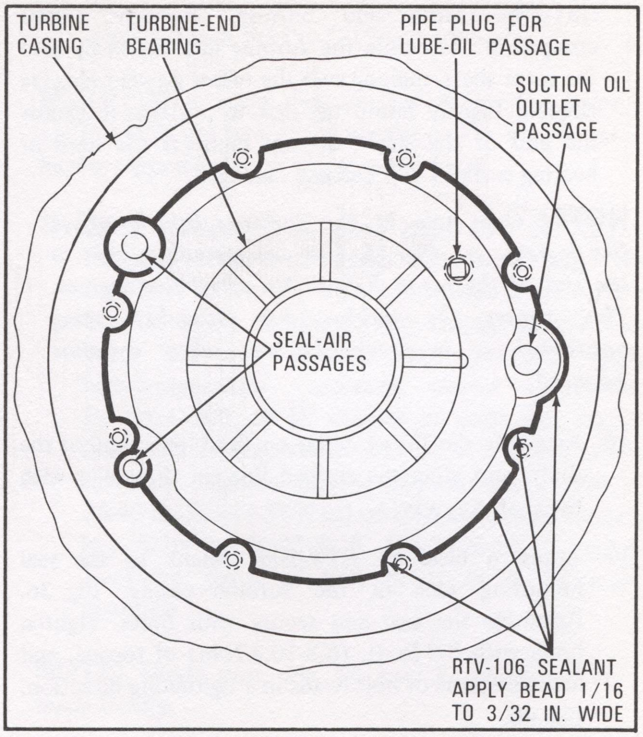
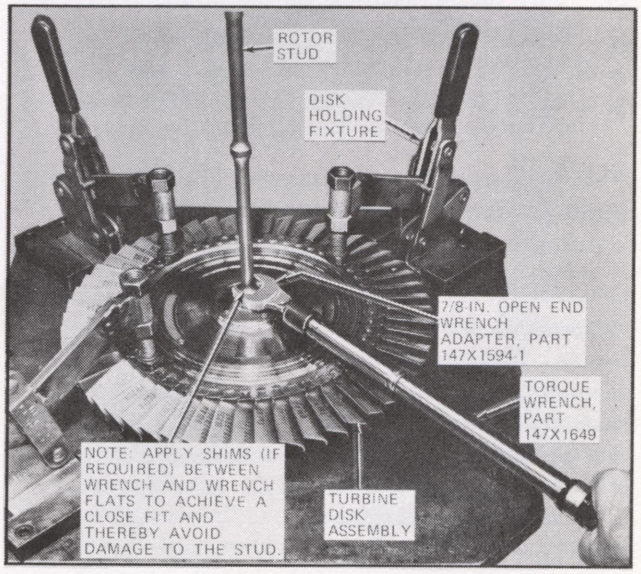

TURBINE CASING
TURBINE-END BEARING
PIPE PLUG FOR LUBE-OIL PASSAGE
SUCTION OIL OUTLET PASSAGE
SEAL-AIR PASSAGES
RTV-106 SEALANT APPLY BEAD 1/16 TO 3/32 IN. WIDE

FIG. 34. APPLICATION PATTERN FOR SEALANT FOR TURBINE-END SEAL.

8. Assemble four split dowels in the turbine end of the rotor shaft with the split edges toward the center of the shaft.

9. Apply anti-seize compound, Fel-Pro C-100, to the turbine-disk hub outside diameter. Apply with a


ROTOR STUD
DISK HOLDING FIXTURE
7/8-IN. OPEN END WRENCH ADAPTER, PART 147X1594-1
TORQUE WRENCH, PART 147X1649
TURBINE DISK ASSEMBLY

NOTE: APPLY SHIMS (IF REQUIRED) BETWEEN WRENCH AND WRENCH FLATS TO ACHIEVE A CLOSE FIT AND THEREBY AVOID DAMAGE TO THE STUD.

FIG. 35. SECURING ROTOR STUD TO TURBINE DISK ASSEMBLY.

FIG. 32, E-23511A

FIG. 33, E-26207

FIG. 34, E-26225B

FIG. 35, E-23460

lint-free cloth and burnish. Remove excess compound. Assemble the turbine disk assembly into the rotor shaft, making sure the offset dowel holes are aligned. Lightly bump the disk to position it against the end of the shaft; do not bump it too hard or bearing surfaces will become damaged.

NOTE: *One hole in the turbine disk is offset five degrees, see Fig. 31. One corresponding hole in the end of the rotor shaft is also offset five degrees. This assures the turbine disk assembly being positioned as it previously was when dynamic balanced.*

10. Assemble the thrust collar on the blower end of the shaft, and align the scribed line on the collar with the shaft keyway.

11. Apply a bead of RTV-106 sealant to the seal mounting face in the turbine casing, Fig. 36. Assemble the seal and secure with bolts. Tighten bolts with 5-8 lb.-ft. (6,8-10,8 N·m) of torque, and lockwire pairs of bolt heads in a tightening direction, Fig. 40.

12. Check the radial clearance between the blower seal bore and the thrust collar which should be 0.0035-0.006 in. (0,089-0,152 mm). This is dimension "G" on Fig. 40.

13. Apply a light coat of Molykote* 321 lubricant to the following areas of the compressor-wheel sleeve:
    a. The face which contacts the thrust collar
    b. The bore adjacent to the thrust collar to a length of approximately 1/2 in.

14. Verify that scribed line on the thrust collar is still aligned with shaft keyway; assemble compressor wheel assembly and align keyways by installing key; then tap end of compressor-wheel sleeve to move it into contact with the thrust collar.

NOTE: *Tap key in until it stops at the groove in the sleeve. This is mandatory to retain rotor balance.*

CAUTION: *Do not strike the outboard end of the compressor-wheel sleeve with a hammer. Use a soft sleeve in contact with the end of the compressor-wheel sleeve to transmit the pushing force necessary to move the compressor-wheel sleeve into final position. This soft sleeve can be made locally of brass or mild steel and should be 2-3/4 in. O.D. x 1-3/4 in. I.D. x 3 in. long.*

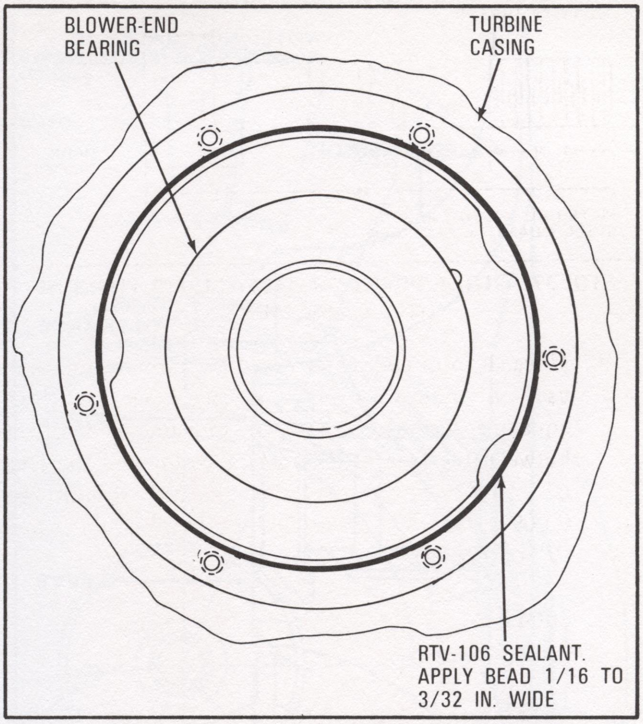


FIG. 36. APPLICATION PATTERN FOR SEALANT FOR BLOWER-END SEAL.

FIG. 36, E-26226B

15. Apply a light coat of Molykote G-n lubricant to the outer surface of the cap taper and the nut contacting surface of the cap. Assemble cap. Rotate cap as required to engage the cap keyway with the key.

16. Apply locknut and, while holding the compressor wheel and the rotor stud stationary, tighten locknut to 100 lb.-ft. (136 N·m) of torque. Loosen locknut and retighten to 80 lb.-ft. (108 N·m) of torque. If necessary, increase torque to align the prick-punch match marks on the nut and cap. If rotor components are properly reassembled, nut should not be advanced more than one flat (1/6 turn). Use torque wrench, Part 147X1649, and 15/16 in. box wrench adapter, Part 147X1778, to tighten locknut.

17. Rotate the rotor assembly to assure it turns freely, then measure and record the rotor assembly end-play, which should be 0.012-0.024 in. (0,305-0,610 mm). This is dimension "H" on Fig. 40.

18. Pour a small quantity of clean engine lube-oil into the lube-oil inlet near the top of the turbine casing, then apply a temporary plug to keep dirt from entering the bearings.

19. Move all rotor end-play toward the blower end, then measure the clearance between the turbine disk and turbine seal, which should be 0.031-0.049 in. (0,787-1,247 mm). This is dimension "I" on Fig. 40.

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*Product of Dow Corning Corp.

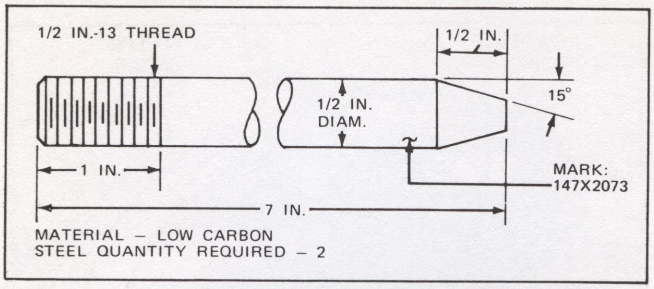

FIG. 37. GUIDE PINS FOR INSTALLING TURBINE INLET ASSEMBLY.

FIG. 37, E-26227

20. Move all rotor end-play toward the turbine end, then use an indicator on a surface gage at three equally-spaced locations to measure the offset between the face of the turbine casing and the face of the compressor wheel. This should be 0.009-0.031 in. (0,229-0,787 mm) and is dimension "J" on Fig. 40.

21. Sub-assemble the turbine inlet assembly in the following manner:

    a. Sub-assemble the nose piece, the correct nozzle ring (see Table III) and the retainer. Secure with six new bolts and locknuts. Apply liquid, nonflavored milk of magnesia to bolt threads before assembly. Tighten bolts and nuts to 25-30 lb.-ft. (34-41 N·m) of torque; loosen and retorque to 16-20 lb.-ft. (22-27 N·m).

       Check the integrity of this sub-assembly; relative to the nozzle ring, there should be no axial or circumferential movement of the nose piece.

    b. With the inlet flange placed on its exhaust-manifold face, assemble the sub-assembly, made in preceding step, with the nozzle-ring locating lug positioned in the keyway in the flange.

    c. Assemble the shroud in place and secure it with eight new bolts and locknuts. Apply liquid, nonflavored milk of magnesia to bolt threads before assembly. Tighten bolts and nuts to 12-16 lb.-ft. (16-22 N·m) of torque.

NOTE: *Tighten retainer and shroud bolts and nuts using a 1/2 in., 12-point socket (Part 147X2136) or combination wrench (Part 147X2088) on the nuts and a 7/16 in., 12-point deep socket (Part 147X2137) or combination wrench (Part 147X2087) on the bolt heads. Use sockets with torque wrench, Part 147X1822.*

22. Assemble four locating keys to the turbine end of the turbine casing and loosely secure with bolts whose threads and washer faces have had an application of Fel-Pro C-100 compound.

NOTE: *When more than one set of four key holes are found in the face of the turbine casing, use the set having tapped holes for the securing bolts.*

23. After installing two guide pins, Part 147X2073, Fig. 37, in turbine casing bolt holes, align the four keys in the key slots and assemble the turbine inlet assembly to the turbine casing. Secure with bolts and new hardened flat washers. Apply high-temperature anti-seize thread compound, Fel-Pro C-100, to all threads of bolts and tapped holes and to the washer face of bolt heads before assembly. Tighten turbine inlet assembly bolts to 35-40 lb.-ft. (47-54 N·m) of torque; tighten locating key bolts to 20-25 lb.-ft. (27-34 N·m) of torque. Lockwire pairs of bolt heads in a tightening direction.

NOTE: *Guide pins, Fig. 37, may be purchased or made locally.*

24. Working down thru the exhaust discharge opening of the turbine casing and using thickness (feeler) gages, measure the clearance between the turbine bucket tips and the shroud bore at three locations – at 9, 12 and 3 o'clock. If possible, also check at the 6 o'clock position. Clearance should be between 0.020 and 0.036 in. (0,508 and 0,914 mm). This is dimension "K" on Fig. 40.

25. Sub-assemble the blower casing and diffuser in the following manner:

    a. Select the correct diffuser (see Table II), and apply a light coating of Molykote 321 lubricant to the mounting face of the diffuser and to the face of each vane.

    b. Install the diffuser and six flat-head screws. To center the diffuser in the blower casing, tighten the screws in a crisscross pattern in increments up to the final torque of 6-9 lb.-ft. (8-12 N·m).

    c. Stake screws by prick-punching to force diffuser metal into each end of each screw slot.

26. Apply a thin coat of Permatex No. 2 sealant to the blower-casing mounting face on the turbine casing. Assemble the blower casing-diffuser sub-assembly, taking care not to damage the tips of the compressor wheel, and secure with bolts and lockwashers. Tighten bolts in a crisscross pattern in increments up to the final torque of 55 lb.-ft. (75 N·m).

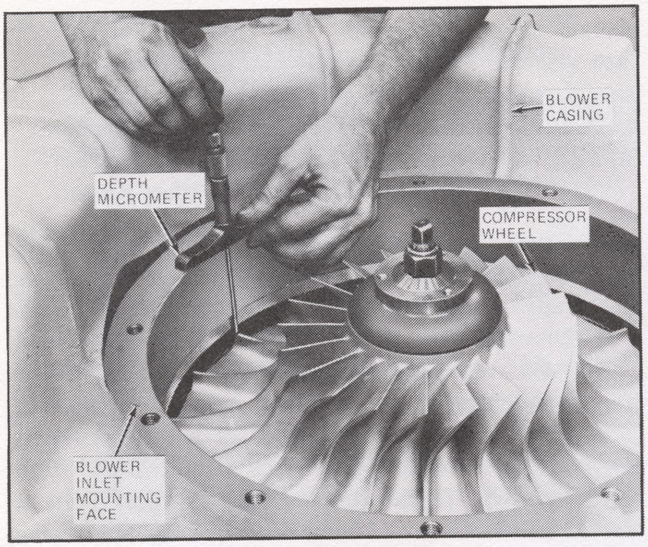

FIG. 38. CHECKING DIMENSION-MOUNTING FACE TO COMPRESSOR WHEEL.

FIG. 38, E-23462

27. Calculate the face clearance between the compressor wheel and the blower inlet (dimension "D" on Fig. 40) in the following manner:

   a. With the turbocharger horizontal and the blower end up (to move all rotor end-play toward the turbine end), check the dimension from the blower-inlet mounting face to the tip of the compressor wheel, Fig. 38, at three locations. DO NOT ROTATE COMPRESSOR WHEEL DURING THIS CHECK. Calculate the average of the three dimensions.

   b. Check the dimension from the blower-inlet mounting face to the inner edge of the blower inlet. This will be dimension "X" on Fig. 39. It is obtained by measuring from the face of a parallel bar (thickness optional but bar must span the complete edge) to the mounting face of the blower inlet, then subtracting the thickness of the parallel bar.

      To compensate for the difference in diameters of the air inlet and compressor wheel, subtract the following amount from "X" dimension in the proceeding paragraph, Fig. 40, View A.

      For Model 7S1616A1, subtract 0.046 in.

      For Models 7S1616B1, B2, B3, D1 and D2, subtract 0.053 in.

   c. Subtract dimension obtained in Step b from dimension obtained in Step a. This is the maximum clearance that will exist between the face of the compressor wheel and the blower inlet.

   d. Subtract the rotor end-play obtained in Step 17 from the dimension obtained in Step c. This is the minimum clearance that will exist between the face of the compressor wheel and the blower inlet and is shown as dimension "D" on Fig. 40.

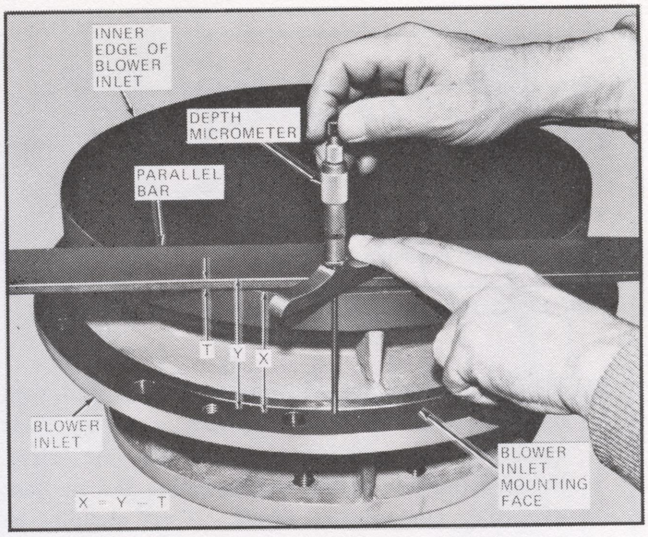

FIG. 39. CHECKING DIMENSION-MOUNTING FACE TO INNER EDGE OF BLOWER INLET.

FIG. 39, E-23463

28. Carefully install the blower inlet to avoid damaging the compressor wheel. Secure with bolts and lockwashers tightened; to 40-50 lb.-ft. (54-68 N·m) of torque.

29. With the turbocharger in an upright, normal position, check that rotor turns freely, then measure the radial clearance between the compressor wheel and the blower inlet at a distance of 1/4 to 3/8 in. in from the face of the wheel. Check at four locations – top, bottom and each side. This is shown as dimension "E" on Fig. 40.

30. Install the seal-air piping, Fig. 1. Make certain arrow on check valve points in the direction shown in Fig. 1. Before installing, shake check valve up and down, and note that valve seats and unseats.

31. Apply pipe plugs to all open pipe-tapped holes; apply fiber-board covers to all air, exhaust, water and oil openings. Apply corrosion preventive compound, Tectyl* 502-C, or equivalent, to all machined mounting surfaces.

> **CAUTION:** *Do not use pieces of cloth to cover openings, since some of this material may get into the turbocharger at installation on the locomotive and cause extensive damage when the turbocharger is put into operation.*

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*Product of Freedom Valvoline Oil Co.

FIG. 40, E-26208A

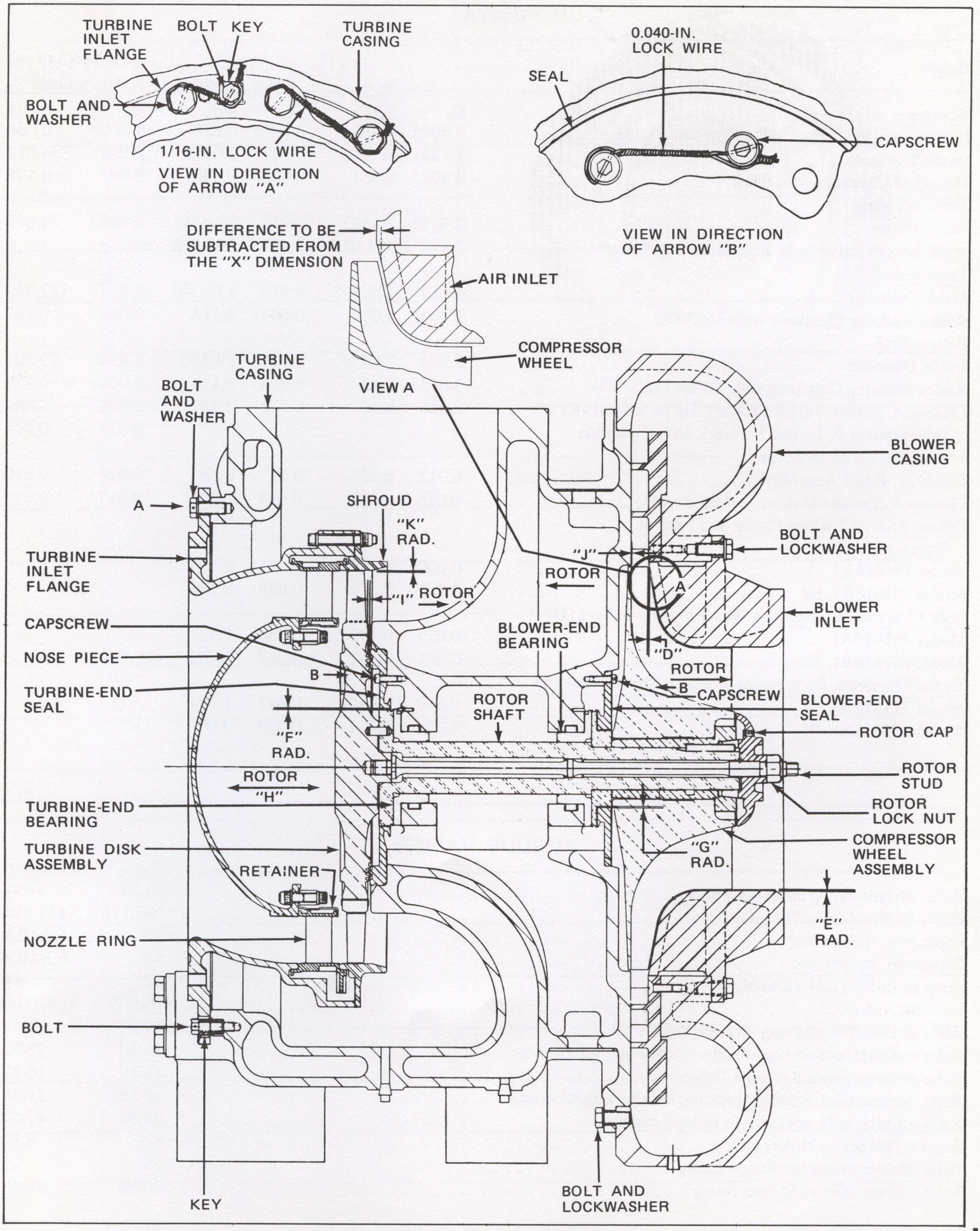
TURBINE INLET FLANGE
BOLT
KEY
TURBINE CASING
BOLT AND WASHER
1/16-IN. LOCK WIRE
VIEW IN DIRECTION OF ARROW "A"
0.040-IN. LOCK WIRE
SEAL
CAPSCREW
VIEW IN DIRECTION OF ARROW "B"
DIFFERENCE TO BE SUBTRACTED FROM THE "X" DIMENSION
AIR INLET
COMPRESSOR WHEEL
VIEW A
TURBINE CASING
BOLT AND WASHER
BLOWER CASING
A
SHROUD
"K" RAD.
BOLT AND LOCKWASHER
"J"
TURBINE INLET FLANGE
ROTOR
A
"I" ROTOR
BLOWER INLET
CAPSCREW
BLOWER-END BEARING
NOSE PIECE
"D"
B
ROTOR
B
CAPSCREW
TURBINE-END SEAL
ROTOR SHAFT
BLOWER-END SEAL
"F" RAD.
ROTOR CAP
ROTOR "H"
ROTOR STUD
ROTOR LOCK NUT
TURBINE-END BEARING
COMPRESSOR WHEEL ASSEMBLY
TURBINE DISK ASSEMBLY
"G" RAD.
RETAINER
"E" RAD.
NOZZLE RING
BOLT
KEY
BOLT AND LOCKWASHER

FIG. 40. TURBOCHARGER CROSS-SECTION.

DATA

Weight . . . . 1430 lb. (649 kg)

	Min. New		Max. New		Worn Limit	
	in.	mm	in.	mm	in.	mm
Bearings						
Interference Fit (Diametral) in Turbine Casing	0.0005	0,013	0.0015	0,038	0.0003	0,008
Inside Diameter	2.124	53,950	2.125	53,975	2.1265	54,013
Diametral Clearance with Shaft	0.0025	0,064	0.0055	0,140	0.007	0,178
Turbine Casing						
Bearing Bore	2.9375	74,613	2.938	74,625	2.9382	74,630
Axial Length Between Bearing Mounting Faces	7.679	195,047	7.682	195,123	–	–
Turbine Seal						
Inside Diameter	4.812	122,225	4.813	122,250	4.817	122,352
Radial Running Clearance with Shaft (F)	0.0035	0,089	0.0045	0,114	0.006	0,152
Blower Seal						
Inside Diameter	3.125	79,375	3.126	79,400	3.130	79,502
Radial Running Clearance with Thrust Collar (G)	0.0035	0,089	0.0045	0,114	0.006	0,152
Clearance, Radial, Turbine Bucket Tip to Shroud (K) (Measured at 9, 12 and 3 o'clock and, if possible at the 6 o'clock position)	0.026	0,660	0.031	0,787	0.020-0.036	0,508-0,914
End-Play, Rotor Assembly (H)	0.012	0,305	0.021	0,533	0.024	0,610
Clearance, Turbine Disk to Turbine Seal (I)	0.020	0,508	0.049	1,247	0.017	0,432
Offset, Face of Turbine Casing and Face of Compressor Wheel (J)						
Model 7S1616A1	0.009	0,229	0.031	0,787	–	–
Model 7S1616B1, B2	0.009	0,229	0.028	0,711	–	–
Face Clearance, Compressor Wheel to Blower Inlet (D)						
Model 7S1616A1	0.029	0,737	0.068	1,727	–	–
Model 7S1616B1, B2	0.031	0,787	0.067	1,702	–	–
Radial Clearance, Compressor Wheel to Blower Inlet (E)						
Model 7S1616A1	0.040	1,016	0.047	1,194	–	–
Model 7S1616B1, B2	0.034	0,864	0.039	0,991	–	–

TORQUE VALUES

	lb.-ft.	N·m
Bolts, turbine-casing clean-out cover	20-25	27-34
Bolts, turbine-casing clean-out flange	105-115	142-156
Capscrews, turbine seal	5-8	6,8-10,8
Capscrews, blower seal	5-8	6,8-10,8
Stud, to turbine disk assembly	60	81
Locknut, rotor	*100/80	*136/108
Bolts and nuts, nozzle-ring retainer, tighten to	25-30	34-41
Bolts and nuts, nozzle-ring retainer, loosen and retorque to	16-20	22-27
Bolts and nuts, shroud to inlet flange	12-16	16-22
Bolts, turbine inlet assembly locating keys to turbine casing	20-25	27-34
Bolts, turbine inlet assembly to turbine casing	35-40	47-54
Screws, diffuser to blower casing	6-9	8-12
Bolts, blower casing to turbine casing	55	75
Bolts, blower inlet to blower casing	40-50	54-68

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*Torque to first value, loosen, then retorque to second (lower) value.